Engineering
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"THE ENGINEER," AUGUST 29, 1930

With METALLURGICAL SUPPLEMENT.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CL.—No. 3894] LONDON: FRIDAY EVENING, AUGUST 29, 1930 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General,

India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for—

SCHEDULE 1.—4254 STEEL AXLES for Carriages and Wagons.

SCHEDULE 2.—328 PAIRS DISC WHEELS with Tyres for Rolling Stock.

SCHEDULE 3.—88 BOILERS for Locomotives.

Tenders due as follows :—

Schedules 1 and 2, 9th September, 1930.

Schedule 3, 23rd September, 1930.

Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 5676

Civil Service Commission.

FORTHCOMING EXAMINATION.

PROBATIONARY INSPECTORS in the Engineering Department of the Post Office (17-23, with extension for service in H.M. Forces).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, CIVIL SERVICE COMMISSION, Burlington-gardens, London, W. 1, GIVING THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 23rd October, 1930. 5647

Crown Agents for the Colonies.

COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/2274.—ENGINEER REQUIRED by the GOVERNMENT OF NIGERIA, for the Maintenance of the Lagos Waterworks, for two tours of 12 to 18 months' service and possible extension. Salary £720, rising to £920 a year by annual increments of £40. Free quarters and passages. Liberal leave on full salary. Candidates, 28 to 40 years of age, must be Corporate Members of the Institution of Civil Engineers and the Institution of Water Engineers. Must have had good experience in the Management of Waterworks, including Triple-expansion Pumping Machinery, Chemical Treatment and Filtration Processes; also in Modern Waste Detection Methods and in the Application of By-laws and Collection of Revenue.

M/2280.—DRAUGHTSMAN REQUIRED for the Survey Department of TANGANYIKA TERRITORY, for 29 to 30 months' service, with possible extension. Salary, £372 per annum, rising to £480 per annum by annual increments of £18. Outfit allowance of £30 on first appointment. Free quarters and liberal leave on full salary. Candidates, 25 to 35 years of age, must be neat and accurate Draughtsmen and Printers, used to Large-scale and Topographical Work; have had experience in Plotting Surveys from field note-books. Must be well up in Calculations used in Surveying, and have a knowledge of Surveying Instruments and Operations. Must be experienced in Survey Drawing-office Work, Methods, and Routine, and in Reproduction Processes for Plans and Maps. Knowledge of Lithography and the Vandyke process is desirable.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 5680

City of Cardiff Education Committee.

THE TECHNICAL COLLEGE.

PRINCIPAL ... CHARLES COLES, B.Sc. (Lond.).

DEPARTMENT OF ENGINEERING.

HEAD OF DEPARTMENT: A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.

SESSION 1930-31.

(Commencing on Monday, 6th October, 1930.)

The following COURSES have been arranged for ENGINEERING STUDENTS :—

A THREE YEARS' COURSE in MECHANICAL and MARINE ENGINEERING, jointly with the University College of South Wales and Monmouthshire.

A TWO YEARS' COURSE for APPRENTICES and others with facilities for practical experience in the Summer Term.

These Courses are suitable for students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.

SPECIAL COURSES are also arranged for MARINE ENGINEERS preparing for the Examinations of the Board of Trade.

OPEN SCHOLARSHIPS, covering tuition fees and maintenance grants of £40 per annum for three years, are offered for competition annually, and candidates for entry to the above Department are eligible to compete.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Application Forms for Entrance Scholarships Examination, duly filled up, must be received before September 20th.

W. J. WILLIAMS,
5669 Director of Education, City Hall, Cardiff.

The Polytechnic, Regent Street, W. 1.

SCHOOL OF ENGINEERING.

President of the School: The Hon. Sir CHARLES PARSONS, O.M., K.C.B., M.A., LL.D., D.Sc., F.R.S.

Head of the School: PHILIP KEMP, M.Sc. Tech., M.I.E.E., A.I. Mech. E., Assoc. A.I.E.E.

Head of Mechanical Engineering Dept.: R. F. THOMPSON, B.Sc. Hons. (Eng.), M.I. Mar. E., A.M.I. Mech. E.

The DAY DEPARTMENT REOPENS on SEPTEMBER 16th, 1930. Entrance Examination commences 8th September, at 9.30 a.m.

Three-year DIPLOMA COURSES in
MECHANICAL ENGINEERING.
STRUCTURAL ENGINEERING.
ELECTRICAL ENGINEERING.
AUTOMOBILE ENGINEERING.

Practice in the Laboratories, Drawing-office, Workshop, and Field.

Fee, 21 guineas per annum.

The EVENING DEPARTMENT REOPENS on SEPTEMBER 22nd, 1930. Students enrolled from 15th September, 1930.

The Day and Evening Courses are recognised for the National Diplomas and Certificates awarded by the Institutions of Mechanical and Electrical Engineers in conjunction with the Board of Education.

Prospectus free on application to the DIRECTOR OF EDUCATION. 5615

The Engineer

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Robert Gordon's Technical College, Aberdeen.

(CENTRAL INSTITUTION.)

The Court of the University of Aberdeen and the Governors of Robert Gordon's Colleges co-operate in the provision of courses leading to the Pass and Honours Degrees of B.Sc. (Engineering) of the University and to the Associateship of the Colleges in the Departments of :—

CIVIL ENGINEERING,
MECHANICAL ENGINEERING,
ELECTRICAL ENGINEERING.

Full-time Day Courses in Mechanical and Electrical Engineering lead to the Higher National Diplomas in these subjects.

Prospectuses forwarded gratis on application to the SECRETARY and REGISTRAR, Robert Gordon's Colleges, Aberdeen. P56

County Borough of Croydon.

EDUCATION COMMITTEE.

TEACHERS are REQUIRED in the following subjects, evening instruction 7.30-9.30, in the Mechanical Engineering Department of the Croydon Polytechnic for next Winter Session, commencing September 22nd.

First Year—ENGINEERING DRAWING, Fridays.
Second Year—ENGINEERING SCIENCE LABORATORY (HEAT, ELECTRICITY and MAGNETISM).
Third Year—ENGINEERING SCIENCE LABORATORY (MECHANICS and HYDROSTATICS).

The fees vary from 15s. per evening of two hours for the lowest appointments to 18s. for the highest, according to qualifications.

Applications, giving particulars of age, education, practical training, experience, present appointment, and residence, should be addressed to the PRINCIPAL, Central Polytechnic, Croydon.

R. B. MORGAN,
Education Officer.

Education Office,
Katharine-street. 5606

PUBLIC NOTICES

Northampton Polytechnic Institute,

ST. JOHN-STREET, LONDON, E.C. 1.

EVENING CLASSES IN

ENGINEERING.

All branches of Civil, Mechanical, Electrical, Aeronautical, Automobile, and Radio Engineering.

APPLIED CHEMISTRY.

Fuels, Electro-plating, Metallurgy, &c.

CLASSES COMMENCE 22nd SEPTEMBER.

Enrolments during the week commencing 15th September.

Free prospectus on application to—

S. C. LAWS, M.A., M.Sc.,
5653 Principal.

University of Manchester.

DEPARTMENT OF ELECTRICAL ENGINEERING.

DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

Full particulars of these Courses will be forwarded on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, OCTOBER 2nd. 5579

Applications from Qualified candidates are INVITED (by letter only) for the following TEMPORARY POSTS :—

ASSISTANT ENGINEERS for Railway Surveys. Candidates must be Chartered Civil Engineers, experienced in Surveying, Levelling, and Draughtsmanship.

SURVEYORS. Expert in Topographical Surveying, including Astronomical Observations and Computations, and Draughtsmanship.

Salaries according to qualifications.

Applications, which should be accompanied by copies only of testimonials, should be addressed to Messrs. RENDEL, PALMER and TRITTON, 55, Broadway, Westminster, S.W. 1, and the envelope marked in the top left-hand corner with the name of the post applied for. 5677

PUBLIC NOTICES

City of Cardiff.

REORGANISATION: WESTERN DISTRICT SEWAGE PUMPING STATION.

TENDERS are INVITED for the SUPPLY and ERECTION of ONE Oil Engine Driven STORM WATER PUMPING UNIT, having a capacity of 700,000 gallons per hour, and ONE Vertical-spindle Electric Motor-driven MAIN SEWAGE PUMPING UNIT, having a capacity of 200,000 gallons per hour, with all accessories, piping, &c., to make a complete installation. Copies of specification, form of Tender and drawings, can be obtained from the office of Mr. Geo. H. Whitaker, M. Inst. C.E., City Engineer, City Hall, Cardiff, on and after Saturday, 30th August, 1930.

Tender, enclosed in sealed envelope and clearly endorsed "Tender, Reorganisation Western District Sewage Pumping Station," to be delivered at the City Engineer's Office not later than 10 a.m., Tuesday, 16th September, 1930.

The lowest or any Tender will not necessarily be accepted.

CECIL G. BROWN,
5649 Town Clerk.

Newcastle-upon-Tyne Electric Supply Company, Limited.

TENDERS are INVITED for the SUPPLY, DELIVERY and ERECTION at the Company's Power Station, Dunston-on-Tyne, of the following PLANT :—

(1) STEEL FRAME BUILDINGS for POWER STATION.

(2) 120-Ton and 25-Ton OVERHEAD ELECTRIC TRAVELLING CRANES.

Copies of the form of Tender and specification (No. N 247) for Steel frame Buildings for Power Station, and (No. N 246) for 120-Ton and 25-Ton Overhead Electric Travelling Cranes, may be obtained from the Company, at Carliol House, Newcastle-upon-Tyne, on the payment of a deposit of Two Guineas per copy of each form of Tender, but not more than three copies of each will be supplied to any one applicant.

After a decision has been made with regard to the Tenders received, deposits will be returned to those who have submitted bona fide Tenders and have not withdrawn them.

Tenders, in duplicate, on the forms supplied, contained in envelopes, endorsed "Tender for Specification No. N 247," or "Tender for Specification No. N 246," must reach the Secretary of the Company not later than Twelve o'clock Noon on the 10th October, 1930.

The Company does not bind itself to accept the lowest or any Tender.

C. SKIPSEY,
Joint Secretary.

Carliol House, Newcastle-upon-Tyne,
22nd August, 1930. 5663

Slough Urban District Council.

TO PUBLIC WORKS CONTRACTORS.

CONCRETE PUMP CHAMBER AND ENGINE HOUSE FOUNDATIONS.

The Council invite TENDERS for the CONSTRUCTION of a CONCRETE PUMP CHAMBER (as an extension to the existing Pump Chamber at Datchet), METER PIT, BORE-HOLE CHAMBER, &c.

Copies of the plan, specification and bill of quantities can be obtained from, and conditions of contract seen, at the Council's Offices on payment of £2 2s. returnable deposit.

Sealed Tenders, endorsed "Concrete Pump House, Datchet," together with plan, specification, and bill of quantities, to be delivered to the undersigned not later than Twelve Noon on Wednesday, September 3rd, 1930.

The lowest or any Tender will not necessarily be accepted.

ALAN BROMLY, A.M.I.C.E.,
Water Engineer and Surveyor.

U.D. Council Offices,
William-street, Slough.
August 15th, 1930. 5619

Corporation of London.

TOWER BRIDGE.

The Bridge House Estates Committee are prepared to receive APPLICATIONS for the POSITION of SUPERINTENDING ENGINEER and BRIDGEMASTER of the TOWER BRIDGE.

The salary of the position will be £750 per annum (no bonus), with residence, fuel and light.

Particulars of the duties of the position and forms of application may be obtained from the Town Clerk, Guildhall, London, E.C. 2.

Applications on the prescribed form must reach the Town Clerk's Office not later than Saturday, the 13th September, 1930. 5652

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PUBLIC NOTICES

Government of Northern IRELAND.

APPOINTMENT OF SENIOR FACTORY INSPECTOR.

APPLICATIONS are INVITED for the POST of SENIOR FACTORY INSPECTOR (MALE), under the Ministry of Labour.

A candidate must on the 30th September, 1930, be 30 years of age or upwards and under 42, unless he has served in H.M. Forces in the Great War, when he will be eligible if under 45 on that date.

He should (a) have had administrative or practical experience, and (b) hold a University Degree in Science (preferably with Chemistry or Experimental Physics as the main subject), or an equivalent qualification.

Salary, £450-£20-£600, plus cost-of-living bonus at the Civil Service rate in force from time to time. During the six months commencing on the 1st September, 1930, the bonus on £450 will be at the rate of £148 4s. per annum. A commencing salary in excess of the minimum may be allowed to the selected candidate if he possesses exceptional qualifications and experience.

Further particulars and forms of application may be obtained from the SECRETARY, CIVIL SERVICE COMMISSION, 15, Donegall-square West, Belfast. Applications, on the prescribed form, must be received not later than the 20th September, 1930. 5674

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

MESSRS. EVANS LIFTS, Ltd., Leicester, Wish to THANK all APPLICANTS for the POSITIONS of Engineer and Design Draughtsman advertised, and to state that the VACANCIES have now been FILLED. P192 A

WANTED by Firm of ENGINEERS' MERCHANTS, a REPRESENTATIVE for the sale of good specialities. First-class salary. Expenses and commission, also car provided to suitable applicant who would be willing to invest not less than £500 in business, which would be secured.—Address, P194, The Engineer Office. P194 A

WANTED by One of the Largest Provincial Omnibus Companies owning a fleet of 900 machines, ASSISTANT ENGINEER or WORKS MANAGER; must be fully conversant with complete overhauls, repairs, running defects and latest workshop practice, also able to institute economical systems. State full experience with technical training, age, and salary required.—Address, P183, The Engineer Office. P183 A

WANTED for a Small Railway in Spanish America (English Company), a GENTLEMAN, public school, to act as resident DIRECTOR MANAGER. He must be experienced, cultured and tactful, with exceptional administrative ability and experience. Fluent Spanish essential, but not engineering. Good salary.—Box "X.Y.Z.," c/o Advertisement Dept., 5, New Bridge-street, London, E.C. 4. 5675 A

WANTED.—
FOUNDRY MANAGER. Must be thoroughly up to date and have sound references as to organising ability and Piece-rate Fixing.
Also fully experienced in Cupola Practice and Mixture of Metals.
Reply giving all necessary particulars.
Address, P207, The Engineer Office. P207 A

WANTED, REPRESENTATIVE FOR SCOTLAND. —Old-established Machine Tool Makers REQUIRE Part-time REPRESENTATIVE (resident Glasgow or Edinburgh), with a knowledge of the trade, on commission and expenses basis.
Address, P164, The Engineer Office. P164 A

A LEADING BRITISH COMMERCIAL VEHICLE MANUFACTURER is prepared to entertain APPLICATIONS from suitable applicants with the following qualifications:—Experience in the Commercial Vehicle industry; able to speak and write Portuguese; knowledge of South America. Full particulars of experience, remuneration required, &c.—Address, 5656, The Engineer Office. 5656 A

ENGINEERING ASSISTANT REQUIRED for Consulting Engineer's Office in Westminster. Experience in Reinforced Concrete Design essential. Knowledge of Foundation and Dock Work desirable. Must be good draughtsman.—Address, stating age, salary required, and full particulars of training and experience, P193, The Engineer Office. P193 A

MESSRS. JOHN HOLROYD and CO., Ltd., Milnrow, REQUIRE a TECHNICAL ENGINEER to Take Charge of their Technical Staff, dealing mainly with the design of Worm Gears. Applicants must have had considerable experience in the design and manufacture of all types of Gears, specially Worm Gears and Worm Reduction Gears. B.Sc. or equivalent qualifications an advantage. Age 30-40.—Apply, giving full particulars and references, to GENERAL MANAGER, John Holroyd and Co., Ltd., Milnrow. 5650 A

REQUIRED by Structural Steel Works in India, FOREMAN. Age not over 30. Must have held similar position in this country.—Write fully, stating age, education, training, present work and wages or salary, Z.R. 434, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 5651 A

SALES MANAGER (Engineering) WANTED, 35-45. Wide experience Bolt Trade essential. Full details education, experience, copies testimonials. Good prospects.—Address, 5678, The Engineer Office. 5678 A

TRAVELLER, with Connection in London and South, WANTED for Grey Iron Castings.—Address, P202, The Engineer Office. P202 A

TWO RESIDENT ENGINEERS REQUIRED in the metropolitan area, with good experience of large Sewerage Works, Tunnelling, River Outfalls, &c. Salary up to £10 a week, according to experience.—Write, stating age, experience, &c., to Box No. 190, c/o R. Anderson and Co., 14, King William-street, W.C. 2. 5660 A

WANTED, SENIOR MARINE DRAUGHTSMAN, experienced in Turbines and Diesel Engines; competent Take Charge Office; good salary to suitable man.—Address, stating full experience and age 5635, The Engineer Office. 5635 A

A COMPETENT DRAUGHTSMAN REQUIRED for a Constructional Engineering Works in East London; only those having a good experience in Structural Steelwork need apply. State age, salary, and experience.—Address, P204, The Engineer Office. P204 A

CONTINENTAL LOCOMOTIVE WORKS REQUIRE the SERVICES of a competent LOCOMOTIVE DRAUGHTSMAN with experience in Garratt design.—Address, with full particulars of experience and salary required, &c., 5658, The Engineer Office. 5658 A

DESIGNER and DRAUGHTSMAN WANTED for about three to four months in London office. Must have had experience on Heavy Timber Construction, preferably Timber Piles and Bracings. Good general knowledge of foundation work is desired. Age not less than 30, and pay would be £6 10s. to £7 10s., according to qualifications and experience.—Write, "T.D." c/o Streets, 6, Gracechurch-street, London, E.C. 3. 5655 A

YARROW HOME and HOSPITAL
FOR CHILDREN
BROADSTAIRS.

For the Early & Preventive Treatment of Disease & Convalescence after illness.

Managed by a Committee appointed by the Council of the Institution of Civil Engineers.

The Hospital is intended for the children of members of the Institution of Civil Engineers, the children of architects, artists, authors, clergymen, members of the medical, legal and other professions, members of scientific societies, officers of the Navy, Army, and Royal Air Force, officers of the Merchant Navy, schoolmasters and university professors.

Accommodation is provided for 50 Boys between the ages of 4 and 12 years, and 50 Girls between the ages of 4 and 14 years. In special cases the age limits may be raised to 14 for Boys and 16 for Girls.

Fee 21/- per week, or as may be arranged, and travelling expenses.

Particulars can be obtained from the Secretary:—
116, Victoria Street, Westminster, LONDON, S.W. 1.

LEASE OF IMPOSING OFFICES FOR SALE.
33, NORFOLK STREET, STRAND, W.C 2.

In consequence of the recent amalgamation of "THE ENGINEER" LTD., proprietors of "The Engineer," with MORGAN BROS. (PUBLISHERS) LTD., proprietors of "The Ironmonger" and "The Chemist & Druggist," the offices of the three journals have now been transferred to new and more commodious freehold premises which have been acquired at 28-31, Essex Street, Strand, W.C. 2.

The remainder of the lease, covering a further twenty-five years, of the offices of "The Engineer" at 33, Norfolk Street, Strand, W.C. 2, is in consequence for sale. This particularly well lighted five-storey building has an area of 8,200 sq. ft., and occupies a site at the corner of Norfolk and Howard Streets, adjacent to the Temple Station, whence Westminster and the City may be reached in a few minutes. The building is of modern construction and has a fine and distinctive elevation. It is in good order throughout, and vacant possession can now be had. Rent £1,600. Moderate price. For further particulars apply to:—

WHATLEY, HILL & CO.,
24, Ryder Street, St. James', S.W. 1.

LEASE OF IMPORTANT CITY OFFICES FOR SALE.
42, CANNON STREET, E.C. 4.

In consequence of the recent amalgamation of Messrs. MORGAN BROTHERS (PUBLISHERS) LTD., proprietors of "THE IRONMONGER" and "THE CHEMIST AND DRUGGIST," with THE ENGINEER, LTD., proprietors of "THE ENGINEER," the offices of the three journals have been moved to new and more commodious freehold premises which have been acquired at 28-31, Essex-street, Strand, W.C. 2.
The lease of the entire premises, of which the four well-lighted upper floors have been in occupation of Morgan Brothers (Publishers) Ltd., the Ground Floor and Basement being sub-let to the Aerated Bread Co., Ltd., is in consequence for sale.
Alternatively, the four upper floors (which have also an entrance to Garlick Hill), having a total area of about 7,000 sq. ft. would be let.
The premises are in good order and vacant possession can now be had. Rent £2,000 per annum, inclusive of rates.

For further particulars apply to:
Messrs. FAREBROTHER, ELLIS & CO., 29, Fleet Street, E.C. 4,
or to
HENRY BUTCHER & CO., 63 & 64, Chancery Lane, London, W.C. 2.

SITUATIONS OPEN (continued)

DRAUGHTSMAN, First-class, REQUIRED IMMEDIATELY for London. Fully experienced in Water-tube Boiler Layouts and Accessories and able to act on own initiative.—Address, fully stating age, experience, and salary required, 5659, The Engineer Office. 5659 A

DRAUGHTSMAN (MECHANICAL) WANTED for large Engineering Works 30 miles from London. Repetition work. Steady job. State age, experience, and salary expected.—Address, 5657, The Engineer Office. 5657 A

DRAUGHTSMEN REQUIRED IMMEDIATELY, fully experienced Jig and Tool Designers; only men having first-class experience of Jigs, Tools and Production Equipment for Automobile Work will be considered. State age and give full particulars of qualifications.—HENRY FORD and SON, Ltd., Cork, Ireland. 5613 A

DRAUGHTSMAN REQUIRED, S. London District, for Light Structural and Mechanical. State wages, &c.—Address, 5684, The Engineer Office. 5684 A

JUNIOR DRAUGHTSMAN (Assisting Estimate Department), smart, intelligent, and quick, Manufacturers of speciality, Barking, Essex. Experience Light Constructional preferred or Architects' Assistant. (Electrical, patent, or motor not desired). Commence £150, progressive permanent employment. Service agreement. State concisely age, previous experience, copy references.
Chosen applicants thoroughly examined on Constructional and Domestic Blue Prints, Metals and speed neatness of draughtsmanship.
Address, 5684, The Engineer Office. 5684 A

STRUCTURAL DRAUGHTSMAN WANTED AT ONCE; man with a little designing and estimating experience preferred. State age, experience, and salary required.—Apply in confidence to the MANAGER, Redpath, Brown and Co., Ltd., 19, Waterloo-street, Glasgow, by letter only. P198 A

SITUATIONS WANTED

AN ENGINEER, with Complete Knowledge of Payment by Results Systems, and the ability to operate same successfully, DESIRES CHANGE.—For further particulars address P190, The Engineer Office. P190 B

COMPETENT EXECUTIVE, Experienced in the organisation and establishment of industries and works on profitable production bases, DESIRES OFFER; exceptional record. — Address, P7186, The Engineer Office. P7186 B

ENGINEER DESIGNER REQUIRES SPARE-TIME DRAWING; general engineering and machine design; 15 years' shop and drawing-office experience. —Address, P197, The Engineer Office. P197 B

GOAHEAD YOUNG MAN (21), London Matriculation, commercial education, thorough knowledge French and Italian, good technical training, one year practical experience, SEEKS FURTHER EXPERIENCE with Mechanical Engineering Firm. Very modest remuneration.—Address, P208, The Engineer Office. P208 B

MECHANICAL DRAWINGS and TRACINGS Neatly executed from sketches by DRAUGHTSMAN, with 15 years' experience in Drawing-office and engineering shop. Estimates given.—Address, P180, The Engineer Office. P180 B

POSITION REQUIRED as ASSISTANT BOOKKEEPER at factory of mechanical engineers. Experience as company secretary, knowledge of heavy machinery, export trade, and several languages.—Address, P206, The Engineer Office. P206 B

FOREMAN ENGINEER DISENGAGED. General, marine, printing, machine shop production, toolmaking, first-class exp., excellent refs., 17 years supervision.—G. A. L., 2, Thurleigh-road, S.W. 12. P203 B

FOREMAN (41), General and Rep. Eng., Gear-cutting, capstans, autos., &c., 15 years' executive experience; London district.—Address, P191, The Engineer Office. P191 B

PARTNERSHIPS

CAPITAL, PARTNERSHIPS, DIRECTORSHIPS.—Any genuine business hampered through lack of capital can be assisted. Arrangements made for formation of Private Limited Liability Company. Underwriting, Mortgages and any sound proposition entertained.—Write, "C. P. D.," c.o. Shelley's, 11, Crooked-lane, E.C. 4. P205 C

£10,000—PARTNER to Manufacture Article for Motor Line at 50 per cent. less cost than at present. Principal only.—Address, P161, The Engineer Office. P161 C

AGENCIES

AN OLD-ESTABLISHED FIRM of STEEL MANUFACTURERS of good standing REQUIRE the SERVICES of an AGENT for the London area; one who has a live connection in High-speed Steel, Tool Steel, and Alloy Steels to add to the existing business should do very well; must be young and energetic. Remuneration would be mainly by commission.—Write in confidence to Box B375, T. B. Browne's Advertising Offices, 163, Queen Victoria-street, London, E.C. 4. 5621 D

ENGINEER-SALESMAN (40), Connection Trade and large industrial concerns in Yorkshire and district, DESIRES REPRESENTATION of Manufacturers of a high-grade speciality.—Address, P196, The Engineer Office. P196 D

MANUFACTURERS have OPENING for Well-established AGENTS with connections amongst Steam Users in principal commercial centres where not already represented. A splendid proposition. —SMITH'S (NON-INCRUSTA), Ltd., Tennyson-place, Bradford, Yorks. 5682* D

EDUCATIONAL

Correspondence Courses
OF PREPARATION FOR THE
Examinations of the
INST. OF CIVIL ENGINEERS,
INST. OF MECH. ENGRS.,
INST. OF STRUCTURAL ENGRS.,
UNIVERSITY OF LONDON, &c.,
are personally conducted by
Mr. Trevor W. Phillips,
B.Sc., Honours, Engineering, London University, Assoc. M. Inst. C.E., A.M.I. Struct. E., M.R.S.I., & F.R.S.A., Chartered Civil Engineer, &c.
For full particulars and advice apply to:—36, DALE-STREET, LIVERPOOL (Tel., Bank 1118). LONDON OFFICE: 65, CHANCERY-LANE, W.C. 2. Ex.

1929 EXAMINATION RESULTS.

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

Trade with the Far East.

The forthcoming departure for the Far East of a strong Economic Mission organised by the Department of Overseas Trade, was announced in our issue of August 1st. The Mission will be charged with the duty of inquiring into the present condition of British trade with China and Japan and of reporting what action should be taken to develop and increase it. In a leading article on page 229 of this issue we deal with the work of the Mission and give important figures and facts which bring out very prominently the need for it. We show that while the disturbed conditions which have prevailed for several years in the Far East are legitimate reasons for expecting a decrease of trade, the diminution of British trade has been excessive, relatively to that of competing nations, some of which have succeeded, in spite of all difficulties, in increasing their business. If we are to regain what we have lost it is essential that British manufacturers interested in the Far Eastern markets should actively support the Mission which is being sent out. The Mission will be accompanied by a special sub-mission dealing with the cotton trade. Both the Mission and the sub-mission will be presided over by Sir Ernest Thompson. Among those serving on the main body will be Lieut.-Colonel Reginald Morcom, of Belliss and Morcom, Ltd., late chairman of the Beama, and vice-president of the Federation of British Industries. The Mission will leave this country on September 19th. Those interested in its work are invited to communicate any views on it which they desire to express to the Department of Overseas Trade at 35, Old Queen-street, S.W.

Electric Lamps.

Within the course of the next few days a reduction is to be made in the price of electric lamps produced by British manufacturers. The reduction will apply to popular types of lamps used for domestic and industrial lighting, and over the whole range the reduction will probably average about 10 per cent., which will still leave the price considerably above that of some of the foreign-made lamps, which are being sold at some of the cheap bazaars at 6d. Foreign competition is apparently severe, but it is being met by efficient organisation and the adoption of the most modern methods of manufacture. Although there has recently been a slight falling off in the demand for electric lamps, the decision to make a reduction in the price was not the result of a lull in trading operations. By efficient equipment and organisation the manufacturers have been able to reduce the cost of production and they are allowing the public to share the benefits resulting from improved methods by lowering the prices. It is hoped that the policy will stimulate the demand for lamps of British manufacture.

A New Broadcasting Station.

On a site at Wester Glen, on the Slamannan road, near Falkirk, the British Broadcasting Corporation has decided to build a new high-power regional broadcasting station, comprising two large buildings, to be erected at a cost of about £50,000. Schedules for work which have been in circulation among local firms have now been returned to headquarters, and when the contracts have been placed, the work will be put in hand. Three different sites were investigated with a view to finding the best position for the station, and the first at Wester Glen, which stands 400ft. above sea level, was ultimately chosen. The second site considered was at Grangemouth road, which is at sea level, and had any difficulties been met with at Wester Glen this site would have been suitable. The third site at Hope Farm, Bonnybridge, is 250ft. above sea level, but it did not meet the requirements of the testing engineers. The opening of the new station, which will give employment to about forty engineers in the district, will synchronise with the closing down of the existing Glasgow station, but the Edinburgh station will not be interfered with.

The British Motor Industry.

It is satisfactory to learn from a statement issued by the British Manufacturers' Section of the Society of Motor Manufacturers and Traders that the British motor industry is not suffering from the trade depression to the same extent as some other industries. During the first seven months of 1930 the exports of motors and motor products from this country were valued at £8,696,005, while the imports in the same time were valued at £3,946,072. In the same period of 1929 the exports were valued at £8,527,959 and the imports at £6,274,910. It will therefore be seen that in a year the excess of exports over imports has risen from £2,253,049 to £4,749,933. It will be observed, however, that this increase has been produced almost entirely by a diminution in the value of the imports and that the exports have remained almost unchanged in value. It is interesting to learn that the decrease in the value of the imports has been accompanied by an increasing demand in the home market for British-made motor vehicles. Overseas, too, according to the Section's statement, British motors are obtaining an increasing hold on the market. The progress made in recent years is being maintained and extended in spite of the financial difficulties and general period of economic depression experienced in Australia and other important overseas markets. Arrangements have been made for discussions to take place between representatives of the motor industry and the Dominion and Colonial Government authorities attending the forthcoming Imperial Conference with a view to developing closer relationships between the Home Country and every section of the Empire. In this connection the Section records with satisfaction the fact that both Australia and New Zealand have increased the measure of tariff preference accorded to British motor vehicles. There are signs, it is added, that similar advantages may be offered by other Empire markets.

The "Hindenburg" Safely Berthed at Rosyth.

On Monday last, August 25th, the ex-German battle-cruiser "Hindenburg," which has been salved by Cox and Danks, Ltd., left Scapa Flow for the Forth, in charge of three German tugs, the "Seefalke," the "Pontos," and the "Ajax." During the past few weeks the ship was pumped out and her hull put into a condition to withstand the 250-mile tow to Rosyth. Before leaving, the tall airshafts which had been secured to the surface of the deck and were utilised for dropping the submerged pumps down to the lower decks were all removed. In the ward room below the boat deck seven oil engine driven generator sets and one air compressor set had been arranged to supply current for eighteen pumps, and provision on deck had been made for the firm's staff and workmen who accompanied the ship south, in two huts. The ship left Scapa Flow on Monday, and the "Sidonian," belonging to Cox and Danks, Ltd., also a small pinnace, accompanied the other tugs until the "Hindenburg" was well out into the Pentland Firth. She arrived at Rosyth on Wednesday afternoon, the passage being made in the record time of two days. Later on she was safely tied up at a berth in the basin. The "Hindenburg" will be broken up by Metal Industries, Ltd., formerly known as the Alloa Shipbreaking Company, Ltd.

The Duke of Northumberland.

The loss which the nation has sustained by the death of the Duke of Northumberland, who was buried in Westminster Abbey on Wednesday of this week, August 27th, is shared by the many naval architects and marine engineers who came to know him during the years of his presidency of the Institution of Naval Architects from 1921 to 1928. The term of the President's office is usually five years, but, at the special invitation of the Council, the Duke consented on two occasions to serve for a further year. During the whole time he never made an engagement with the Institution which he did not fulfil. He endeared himself to all who came in contact with him by his simplicity, kindliness, and sincerity. Naturally, he was less interested in the more technical aspects of the papers which were read and discussed than he was in the broad work of the Institution which he did much to advance. At the opening meetings of each new session and at the annual dinners of the Institution the addresses he gave and the speeches he made were much valued. The distinguished position which he held in this country gave to the Institution and its work a note of dignity and respect which was specially marked in its visits to France, Holland, and Belgium with the Duke as President and leader of the party. His death is felt as a personal loss by many of the Council and members who worked with him. As President of the Royal Institution, the Duke was Chairman of the Committee in charge of the reconstruction of the Institution's building, and it was hoped that he would have presided at the Faraday centenary celebrations which are to take place in September next year.

Proposed Atlantic Liners.

According to a statement which was recently made by Monsieur Louis Rollin, the French Minister of Marine, the negotiations between the Government and the French Line, relating to the proposed construction of a very large Atlantic liner, have now been completed, and it is understood that a contract will shortly be arranged with the St. Nazaire Penhoet shipyards. The building of the new liner, which, it is reported, will have a length of about 1000ft., with from 65,000 to 70,000 tons displacement, is to be completed within four years. The propelling machinery is to be designed for a speed of probably 28 knots, with a view to making the crossing from Havre to New York in five days. It has been suggested that the name of the new liner will most likely be "La Paix." In America the revised plans of the two large liners which the United States Lines are proposing to construct as sister ships to the "Leviathan" have recently been submitted to the Shipping Board. President Hoover has appointed a special shipping committee which will decide the question of the advisability of the Government making an advance of some nine million pounds to aid the cost of constructing the new liners. The proposed liners would be the first of their kind to be built in American shipyards, and although it is felt desirable that the keels should be laid as soon as possible, the whole question is being given careful consideration.

Large Oil Tankers Placed Abroad.

Keen regret is felt in British shipbuilding and marine engineering circles that the orders for the nine large motor oil tankers for the Standard Oil Company of New York have all been placed with continental yards. The officials of the Standard Oil Company came over from America and it was hoped that Great Britain would obtain some share of the work. On the ground of price, however, six of the new tankers will be built and engined in Germany and three in Italy. Each of the new tankers will have a deadweight carrying capacity of about 16,000 tons, and will be constructed on the Isherwood system. Two vessels will be built by the Fried. Krupp Germaniawerft A.G., and Krupp oil engines will be installed, while in the two ships built by the Deutsche Werft A.G. of Hamburg, and the two by the Bremer Vulkan Schiffbau und Maschinenfabrik of Vegesak, M.A.N. motors will be fitted. All three of the tankers placed in Italy will be built at the Cantiere Navale Triestino yard, Monfalcone, and will be equipped with Fiat machinery. It will be recalled that in the issues of The Engineer of November 1st and 8th last year we described the specialised method of hull construction adopted at the Monfalcone yard, the essential principle of which is the centralising of practically all the skilled work in the mould loft, enabling the plates to be marked off, punched, and bent to the desired shapes without referring them to the ship in course of construction on the stocks. The competitive advantages of such a system compared with our own methods were strongly emphasised in our articles.

A Probable Second Cunard Liner.

According to Mr. J. J. Lawson, Parliamentary Secretary to the Ministry of Labour, it has now been definitely decided by the Government that a second large Cunard liner is to be built on the Tyne. The construction of the first Cunard liner has been entrusted to John Brown and Co., Ltd., of Clydebank, but in a recent official statement by the Cunard Steamship Company relating to a Government guarantee for part of the insurance risks, it was mentioned that the insurance scheme covered the possible construction of two sister ships. The hope is expressed that the building of the second ship will be entrusted to Swan, Hunter and Wigham Richardson, Ltd., of Wallsend, which firm, in conjuction with the Wallsend Slipway Company, Ltd., built and engined the "Mauretania." Mr. Lawson also referred to schemes for the improvement of Tyneside docks, and hinted that the development of merchant shipbuilding might be aided by the Government, it having been proposed that for every 2,000,000 tons of ships scrapped in this country £1,000,000 should be spent on the building of new ships. This scheme, Mr. Lawson stated, is to be considered by Mr. William Graham, President of the Board of Trade.

A Famous Locomotive.

It is learned that the London, Midland and Scottish Railway is about to withdraw from service what is stated to be the last single driving wheel express locomotive running in Scotland. This engine, an old Caledonian locomotive, was built by Neilson and Co. at Hyde Park Locomotive Works in 1886 and was exhibited at the Edinburgh Exhibition of that year. It has 7ft. driving wheels with a four-wheeled bogie and a pair of wheels beneath the fire-box. Its cylinders are 18in. in diameter and have a stroke of 24in. In 1888 this locomotive took part in the railway races between London and the North which distinguished that period of railway rivalry. At one time it was preserved at Glasgow solely for the purpose of drawing the directors' saloon, but for some years past it has been stationed at Perth and has worked on the service between that town and Dundee. It is now to be repainted in its original Caledonian blue and will take part in the forthcoming centenary celebrations of the Liverpool and Manchester Railway. There are, or have been, many engines at work more than forty-four years after their first appearance on the road, but the passing of this old Caledonian locomotive is of peculiar interest in view of the fame which the single drivers acquired in the days to which they belonged.

U.S. Naval Economy.

Additional news has been received this week concerning the plans being made by the United States Government to economise expenditure on its navy. It is reported that a scheme is being considered for closing all the navy yards except two on the Atlantic Coast and two on the Pacific, a procedure which, it is estimated, would save £2,000,000 a year. Many of the yards and bases which it is proposed to eliminate were established during the war. Two yards in the Pacific, it is said, are sufficient to meet all the needs of the 65 per cent. of the navy concentrated on that coast. Two Atlantic bases plus the assistance of private yards could, it is argued, adequately serve the remaining 35 per cent. of the fleet.

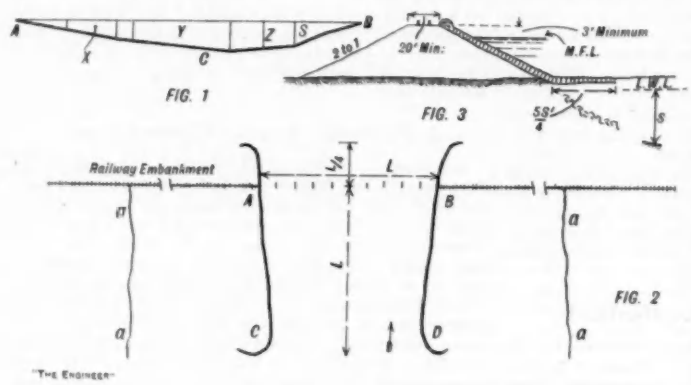
Flowing Water.

No. III.*

By J. M. LACEY.

THE most difficult part of an engineer's task is, very often, to determine the amount of opening or waterway to be given to a bridge or culvert. Where the banks are well defined and the river or stream does not overflow them, the problem does not present the same amount of difficulty as when the dry weather supply is small and in flood season the flow is large, often spreading over the country. The question then becomes one of intricate calculation, inasmuch as it is difficult to determine what portion of the water is moving and what is mere back water. As already pointed out—"Flowing Water, II., THE ENGINEER, May 30th, 1930—an engineer in charge of a district or a length of railway or a canal system can seldom have an opportunity at the critical moment of flood peak to be on the spot to measure its height and gauge its volume, and he has perforce to depend on empirical formulæ for determining the proper waterway. That the subject of this largely unsolved problem of estimating the flood discharge of a stream from its catchment basin is important, is evident from the numerous formulæ extant for estimating the capacities of culverts and flood openings. That it is yet indeterminate, is clear from the many instances of the inadequacy of culverts and bridges.

Let A C B represent the flood section of a stream and A B its flood line—Fig. 1. If the areas of each compartment X Y Z S are measured and the velocities of the water through each ascertained, the volume of flood water passing down will be known. From the hydraulic conditions of the river the amount of waterway necessary to pass the whole volume of flood water at the natural velocity of the river can be calculated. This width of opening would, in many rivers, be inconveniently great; an engineer is therefore obliged to incur some risk by confining the flood to narrower bounds, causing a heading up, or afflux, above the bridge and an increased velocity through it in proportion to the height of the afflux. The permissible afflux will depend on the nature of the stream bed, the design and depth of the foundations of the bridge or culvert, and the nature of the flooring and stone pitching if provided; so that the resulting scour shall not undermine the structure. The permissible afflux will also have to be considered in regard to the height of the approach embankments and possible spill over levees. In short, the ideal condition would be that the stream, at its highest flood, should pass through the opening provided for it at the natural velocity, due to its slope and other factors, so as to avoid such an afflux as might deepen its bed by scour. In practice, however, the structure of the bridge or culvert should be so designed and built that a certain amount of scour will not do any harm. It is generally considered that a velocity of 5ft. per second through a flood opening should be the limiting velocity, where the foundations of the structure do not rest on firm soil or are not carried to a great depth. But Mr. G. Charnier says: "Given the greatest discharge to be anticipated at any outlet, the area to be assigned to the opening will depend on the greatest velocity of flow that it may be deemed safe or advisable to permit." Where a culvert or conduit is subject to a constant discharge as in the case of underground sewers, it is advisable to provide for a slow and steady flow to avoid erosion of material or scouring away of foundations. In such circumstances the velocity of the stream is generally limited to about 5ft. per second. The case is different for short waterways that may not have to discharge a flood once in many years, and then only for a period of a few hours. Mountain streams and flooded rivers often approach the openings with velocities of 10ft. to 12ft. per second and even greater, and all waterways should be suitable for carrying any stream at its highest natural velocity. There is no reason why flood openings on such rare occasions should not be taxed to their utmost safe carrying capacities, or that culverts should not be allowed to discharge under moderate pressure. Care must be exercised in all cases to secure the foundations of structures from the action of scour; but, apart from this, a velocity of 10ft. per second may generally be safely allowed. Nor is there any necessity for a margin of safety in the dimensions of the opening, because a maximum of rainfall has been provided for in the calculation of the greatest flood discharge—"Proc." Inst. Civil Engineers, Vol. CXXXIV., pages 320, 321.



FIGS. 1, 2 AND 3

Where a river bed is wide and irregular, being formed in the midst of movable sand banks, through which the water finds a continual shifting channel or several shifting channels, training and regulating the bed becomes necessary so as to constrain the river to flow in a single channel through the bridge opening. In connection with the construction of railway bridges across the wide rivers of the Netherlands, the object to be held in view was to accommodate the clear openings to the requirements of the river discharge in different states, so as to obtain the least possible disturbance in the currents and surface gradients. If the opening were too small, so as to cause a diminished surface gradient above the obstruction, the current through the opening would inconveniently increase. If the widening at or near the spot were in excess, there would be the danger of silting up occurring in undesirable places and troublesome changes in the river bed below. As an instance, at the railway bridge at Buggenum, near Roermond, the line crosses at a double bend in the river Maas, where the permanent deep or summer channel lies between extended foreshores, submerged during floods. The total width from bank to bank is about 5330ft., of which the deep channel occupies 330ft. During floods 77,700 cusecs pass down the river, and during an exceptional flood the discharge amounted to 92,000 cusecs. In floods, only a part of the total flows down the deeper channel, and the rest over the shallower foreshores at a diminished velocity. It would have been extravagant to provide for the whole of the maximum flood discharge by open viaducts in the long approaches instead of using the cheaper embankments. The problem was to determine the probable effect of such an obstruction, and the size of opening required in the principal work so as to avoid an excessive current through the piers and abutments, and prevent diminished velocities leading to changes in the river bed in the lower reaches—*vide* "Proc." Inst. C.E., Vol. CXLIX., page 387, and Paper No. 3340, page 157 *et seq.*, *Ibid*, Vol. CLII.

The extreme regularity of the course of our rivers has so simplified the difficulties connected with works intended to conserve and control them, that very little attention has been paid to the subject by English engineers. In many rivers abroad the margins are conserved by a series of spurs, without returns, projecting into the stream, and attached solidly to the bank. It was considered that they protected a length on the upper side of double their projection, and on the lower of three times the same length; but they were found to produce sinuosities in the course of the stream, and to determine strong corrosive actions on the downstream side. Moreover, the heads of the spurs themselves were much exposed to the undermining action of the waters. The dangers of the use of spurs are most strongly developed during floods. In ordinary states of the river the water which passes into the angles formed by the spur becomes stagnant, or it turns slowly, especially on the upstream side, and allows a deposition to take place; but when extraordinary floods occur, and the velocity of the stream becomes great, the rotary motion of the water not infrequently produces a whirlpool, which injures the margins and the works of the spurs themselves. The spurs, in fact, give rise to a destructive action more powerful than the one they were intended to protect. Works for the conservation of river margins and control of the waterway are executed in many different ways, according to the nature of the soil, the course of the river, and above all according to the nature of the materials to be met with most readily and at the cheapest rate.

A work in which the cheapest and at the same time one of the most effectual methods of constraining a river is that of the Midouze between the Port de Marsan, and its embouchure into the Adour, for a distance of between 25 and 26 miles. The width of the "pass" created varied between 71ft. and 91ft.; the variation in the width being equally divided into four parts, and the limits of the new bed of the river were comprised between two concentric curves. The original bed of the Midouze was very wide and irregular, and the river even in its normal state carried down great quantities of mud and sand. The system adopted was to form spurs of a kind of wattling which were connected at one end with the bank, and at the other projected into the stream as far as the line of the intended new channel. The spurs were placed at distances 133ft. apart, and exactly opposite to each other, where they were to be fixed to the banks on both sides. They terminated towards the stream by returns in the shape of the letter T, each of whose branches was 17ft. long. The spurs were formed of pickets placed about 1½ft. apart. The pickets were of willow, 3in. to 5in. in diameter, and driven over 4ft. into the ground, leaving 1ft. clear above low water level. Between the pickets a wattling of about 3½ft. mean height was executed with branches of willow, between 7ft. and 10ft. in length and about 1in. in diameter. They were kept in their places in the upper part by means of oak plugs driven through the heads of the picket, to prevent their rising during floods. Independently of the main spurs attached to the banks, two minor spurs about 44½ft. centre to centre, with returns measuring 33ft. over both branches, were inserted between the main spurs. They were composed of young trees, 4in. to 6in. in diameter, the length of the trees and their branches being not less than 10ft., and diameter over branches 5ft. The object of their insertion between the main spurs was to facilitate the deposition of mud and sand. A "pass" or waterway was opened between the main spurs to a depth of at least 1ft. below the lowest summer water level, and the material excavated was thrown between the spurs. As soon as an artificial bank was formed by the excavations for the "pass" and by subsequent accretion, it was planted up with slips of willow, osier, poplar, or other aquatic trees, placed 6½ft. apart, inclined to break any current which might be formed beyond the regular "pass." Heath and grasses were planted between the trees. This method of forming the bed of the Midouze succeeded remarkably well, and was carried out into effect at comparatively trifling expense—extract from "Annales des Ponts et Chaussées," for the year 1831.

The effects of the action of running water upon different beds are, however, so various that what is highly successful in one case may not succeed in another. On the Continent it may be said that as a general rule the only certain mode of deepening the bed of a river is by the establishment of low longitudinal dykes placed along either side of the low water channel some distance forward from the banks, but connected with them at intervals by cross dykes at the back to prevent the current from scouring out a channel behind them during floods. By raising these dykes slightly above the surface of the bed of the river, except where an old channel of the river is closed or the course of the river is rectified, the capacity of the channel for discharging floods is not affected, for the slight obstruction to flow produced by the dykes at the sides is fully compensated by the deepening of the low water channel in the central course of the river.

The materials employed in the execution of these dykes vary with the nature of the country in which they are situated. On the Rhone below Lyons, with its rapid current, the dykes are constructed of rubble consolidated above low water with concrete. On the Rhine the dykes consist chiefly of earth protected by a layer of rubble-pitching on the face, with a rubble mound forming the toe exposed to the current. Also fascines protected by stone or simple rubble mounds are used to form dykes. On the Waal the dykes consist of a core of sand protected by a mattress weighted with stone—*vide* "Proc." Inst. C.E., Vol. CLII., page 201.

FOUNDATIONS.

Where solid ground exists, and in the case of streams with sand beds where the current is not strong and where the natural waterway has not been much diminished, provided the sand is kept free from the action of running water or other disturbing factors, the design of suitable foundations does not present any great engineering difficulty. On the other hand, when the depth of sand is great and scour during floods considerable, the design of the foundations of a bridge requires careful consideration. There are two ways of securing the safety of bridges across such rivers. By building them on shallow and protected foundations, or by carrying the foundations to rock or hard material, or to a depth beyond that to which scour can extend, the superincumbent weight being supported by skin friction alone. It had been the custom in South India for many centuries to use well foundations where soft ground was met with. The least size for a foundation well was 3ft. internal diameter and 4½ft. external diameter, and the largest 6ft. external diameter and 4½ft. internal diameter. The wells were sunk 3in. to 6in. from each other, in rows oblique to the face of the work, and 6in. beyond the lowest course of the masonry. The wells were built on curbs of mango wood and the bricks, cut to fit the curve, were usually laid in clay. When the wells were finished they were bound horizontally with ropes of straw, a well ring was then laid on the top course of each well, and they were bound vertically with coir ropes, which were removed after the wells were sunk. The wells were cleared out by professional well sinkers, using hand implements. When a well was sunk it was filled with clinker, shingle, or any material that did not dissolve in water and which could be rammed. The greatest depth a well-sinker could work in water was 8ft. to 9ft.

In later years these wells were improved upon, and were built of brick in mortar; but the depths they were sunk to in water remained the same. In the Madras Presidency the piers and abutments of the bridges on the trunk roads were built on wells sunk some 8ft. or 9ft. into the sand bed of the rivers they cross; the piers being connected together, both at

* No. II. appeared May 30th, 1930.

their up and downstream ends by a line of wells acting as curtain walls. To prevent scour, a flooring of masonry or concrete is laid between the piers, and an apron of dry stone is added on the downstream side beyond the curtain walls. These shallow protected foundations did not find favour in the north of India, presumably because the sands in the rivers there were considerably finer than the river sand of Peninsula India. The latter, derived from the *débris* of the basement gneiss of the peninsula, consist mainly of quartz fragments with an average "effective size" of 0·02 and 0·03 of an inch, whereas the Himalayan sands of the Indus and the Ganges, derived from a later geological formation, are mainly micaceous in character with an "effective size" of 0·01 to 0·008 of an inch and finer.

The practice in North India, before modern appliances were available, was to support the abutments and piers of bridges on wells, or on blocks of masonry, each block containing three or four shafts or wells in which the excavation was carried out. As long as the water in the interior could be kept down by lifting, the work of sinking proceeded quickly; but when the work had to proceed under water it became slow, and the material from the interior of the well was removed by the use of the "jham"—a large hoe or scoop of wrought iron, still used by the agriculturists of North India for excavating their irrigation wells—*vide* "Hydrology and Ground Water," by writer, Chapter IX., page 113. The well foundations were sunk to over 40ft. by this means, but in many cases even this depth proved insufficient owing to the great depth of scour during floods in those rivers—"Proc." Inst. C.E., Vol. CXXXIV., pages 84 and 100. The absolute stability of a shallow foundation bridge if protected by flooring and rubble stone to arrest underscour, has been proved in many cases even when discharging under heads, or afflux, of several feet. The amount of permissible afflux will largely depend on the nature of the stream bed, material used, design of the structure and judgment of the engineer. Gen. Mullins, R.E., points out that the best arrangement or design for a bridge depends upon locality and circumstances; but if suitable stone is cheap and abundant, and if during a considerable part of the year the river bed has little visible water, it is probable that shallow protected foundations will be found more economical than foundations carried down to rock or other reliable material when this is not reached within 35ft. to 40ft. below the surface of the river bed—"Proc." Inst. C.E., Vol. CXXXIV., pages 112–113.

Where a river straggles about over a wide valley or depression, and where the waterway of a bridge across it has been constricted, and where the river itself has not been constrained by suitable works so as to flow in a single channel, it is obvious that the stream should flow square to the bridge opening. In order, therefore, to prevent erosion of the approach embankments by the flood water running parallel to their base, and to prevent swirl round into the current through the bridge, a pair of training banks is usually provided to run out, upstream, at right angles to the bridge. Their length will depend on the strength of the current, and they are protected by stone revetment or other means against scour and wave wash.

The principles of shallow protected foundations for structures across rivers whose sand beds extend to great depths has now become a subject of considerable technical interest—*vide* "The Practical Design of Irrigation Works" (Bligh); "The Control of Water" (Parker); paper No. 4004, "Proc." Inst. C.E., Vol. CXCVII. (Griffith). A noteworthy example is the Asyût Barrage across the Nile, a description of which is given in "Proc." Inst. C.E., Vol. CLVIII.

In deep perennial rivers, and in the case of the large rivers of India, where there is always a great depth of saturated sand, and which during floods are subject to considerable scour—"Flowing Water," II., THE ENGINEER, May 30th, 1930—it is desirable for reasons of safety that the foundations, particularly in the case of railway bridges, shall be carried down to a solid sub-stratum or to such a depth as to be below all possible danger from scour. As already pointed out—"Flowing Water," I., THE ENGINEER, May 23rd, 1930—the flow is not the same in the whole transverse section of a river when in flood. A large river in India coming down in flood first deepens and widens its low water, or cold weather channel, which becomes the "Live-stream" of the river. When, from the conditions of velocity and volume of flow obtaining, the capacity of enlargement of the "Live channel" is reached, the river spills over this channel, and spreads over its valley, the waters extending in some cases to several miles across from one high margin to the other. These "internal spills" are carried back to the main stream by "Live creeks." In extraordinary floods the river may spill over its alluvial margins, as "external spills," and flood low-lying lands, unless they are protected by flood embankments or levees—*vide* "Proc." Inst. C.E., Vol. CCXVI., pages 150, 151, 152.

In former years engineers had treated the profile of a river made in the dry season as permanent, irrespective of the possible deepening of its bed by scour. It is now recognised that, synchronously with the rise of flood level there is a scouring and enlargement of the sand bed of a river. Therefore, where a narrowing or constriction of the waterway occurred at a bridge, the depth at the bridge site increased until the limit of the river's natural depth of scour had been reached. The method now adopted in the case of railway bridges over the large rivers of India is not to allow the river to straggle or wander over a wide valley, thereby exposing a long length of bridge to diagonal attack during floods, when conditions may arise in which the whole volume of flood may set against a fraction of the waterway, causing abnormal scour, but to throttle or constrict the approach to the bridge opening by training embankments, thereby restricting the width of the bridge to that necessary to discharge the maximum flood after allowing for a limited amount of enlargement by scour so as to adjust the sectional area to such discharge.

The "Bell Bund" system of training banks derives its origin and name from Mr. J. R. Bell, M. Inst. C.E., some time Consulting Engineer for Railways to the Government of India. The objective is to confine the flood stream of a river by training banks, so that its scoured channel should have a straight run through the bridge. The training banks, or "Bell Bunds" as they are called, are carried straight up stream from the abutment, at right angles to the railway embankment, and slightly converging upstream towards the centre of the stream, so that if the correct convergence has been arrived at the current would spread out, and by the time it reached the bridge its velocity would be fairly uniform across the width of the bridge pit, and give a uniform scour. With diverging banks the main flood current may hug one or other bank and cause local scour. The extent of contraction at the upstream end of the bunds will depend on the number of piers, as the piers subdivide the channels, that a much narrower width at C D—Fig. 2—gives a larger and more effective channel than that afforded at the bridge A B—*vide* Mr. J. R. Bell's Note of August 25th, 1890, in "River Training and Control on the Guide Bank System," 1903, by Mr. (now Sir) Francis Spring.

Fig. 2 gives a diagram of the Bell system of guide banks; the length of the training banks up and downstream of the bridge are those laid down by Mr. J. R. Bell in his Note quoted above. *a a* . . . are "Retired Embankments," and confine spills where the ground is low, and whose height depends on the permissible afflux. Where a river runs between high alluvial margins these "Retired Embankments" are not necessary. It is obvious that the length of the Bell bunds upstream should be such that the maximum acute bend—see "Flowing Water: I.," THE ENGINEER, May 23rd, 1930—that may naturally occur in a river, cannot reach up to and erode the railway embankment.

Fig. 3 is a typical section of the bund. The core is made generally of sand from the river bed, the slopes of clay. The inner or river face should be protected by stone revetment laid preferably on a layer of riprap, about 1ft. in thickness. The revetment should be hand packed, so as to obtain a smooth surface. A reserve of stone is also piled up on the upper part of the bund slope. A stone apron of width equal to $^{3}/_{4}$ of the maximum anticipated scour is provided along the entire length of the river face and round the ends. The apron should be sunk in the river bed and the excavation used to make up the bund. If more material is required it should be excavated from the inner berm. The top of the bank carries a permanent line of rails for replenishing the stone should repairs in excess of the reserve be necessary. The back slopes are wattled and planted against wave wash. The stone for the apron and the revetment should preferably be sharp-edged, the weight of the stone increasing with the anticipated velocity through the bridge. Mr. Bell in his Note gives as a guide that if the velocity is 6ft. per second the average weight of stone should be 1 cwt.—*vide* also pages 26 and 27, "Proc." Inst. C.E., Vol. CLIV. A good deal of discussion has taken place as to the shape of the *vena contracta* and the splayed ends—"Proc." Inst. C.E., Vol. CLXXIV., paper 3626.

The question that naturally arises is to what extent can the waterway be constricted so as to avoid excessive afflux above and undesirable velocity through the bridge. The constriction should be as great as possible to prevent any local scour through the "Pass" formed by the guide banks. In the "Pass" the scour should be "free," and for this reason stone pitching round the piers is deprecated. The extent of scour, and the afflux required to produce that scour, depend on the grade of the sand forming the river bed. The practice is based on the result of past successes or failures. Mr. W. M. Griffith states that "The Theory of Silt and Scour"—paper No. 4545, "Proc." Inst. C.E., Vol. CCXXIII—applied to the design of bridge foundations offers a means of calculation of the probable depth of scour near bridge foundations due to the contraction of waterway.

In paper No. 4736, read at the Institution of Civil Engineers on January 28th, 1930, Mr. Gerald Lacey gives what he terms a useful approximate formula for the minimum width of stable waterway of large rivers in alluvium—*vide* equation (6), page 19, of the paper.

Whatever system of river control is adopted it is indispensably necessary that any defect be remedied at once. Constant inspection, great care, and continual labour are the only means by which the regime of rivers can be maintained. No short-sighted notions of economy should be allowed to interfere with the organisation of an efficient system of maintenance.

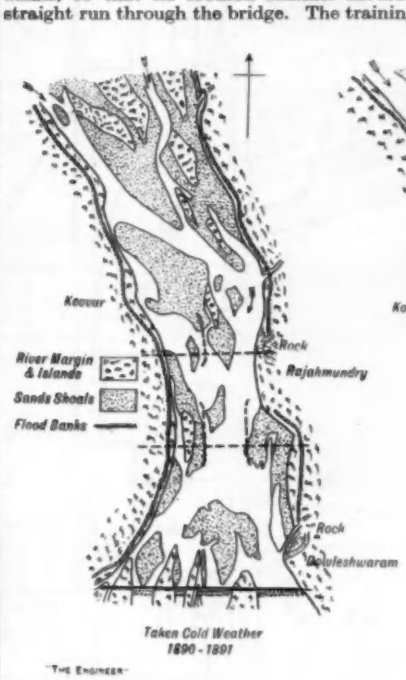


FIG. 4

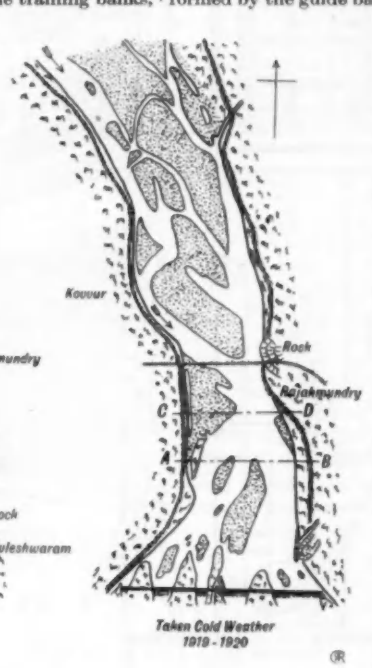


FIG. 5

Fig. 4 is a survey of the Godavery River at Rajahmundry, South India, taken in the cold weather, 1890–91—that is, during the low-water period, the water level being at the crest of the anicut at Dowleshwaram. The crest of the anicut is 38·75ft. above mean sea level, and the cills of the head sluice of the canals taking off above the anicut are 32·00 M.S.L., so that the crest of the anicut is some $6\frac{3}{4}$ft. above an assumed mean bed of the river. At the time this survey was made the "live channel" of the river flowed down the eastern or Rajahmundry margin; the Kovvur channel being its concomitant creek. At Rajahmundry the "live channel" has adhered to a rocky flank, and hugs the margin, so that there is always about 28ft. to 30ft. of water opposite Rajahmundry at low water. In flood the bed at this margin is cleaned to rock. The first proposal for constructing a railway bridge across the Godavery River was to constrict the river at the Rajahmundry flank, as shown in broken lines. This was not generally approved of, one reason being that the river was making a determined set on its right margin above Kovvur, and it was anticipated that the Kovvur Creek would in time become the "live channel" of the river. Also if the set worked down to Kovvur, not only the safety of the railway embankment, but that of the low valuable paddy lands lying to the south-westwards of Kovvur would be endangered. The alternative proposal was to construct the bridge

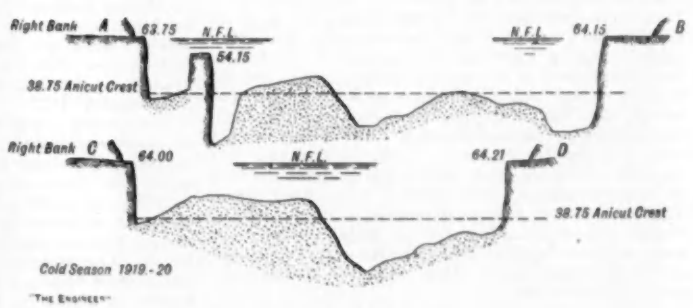


FIG. 6

THE PERAK RIVER HYDRO-ELECTRIC POWER SCHEME

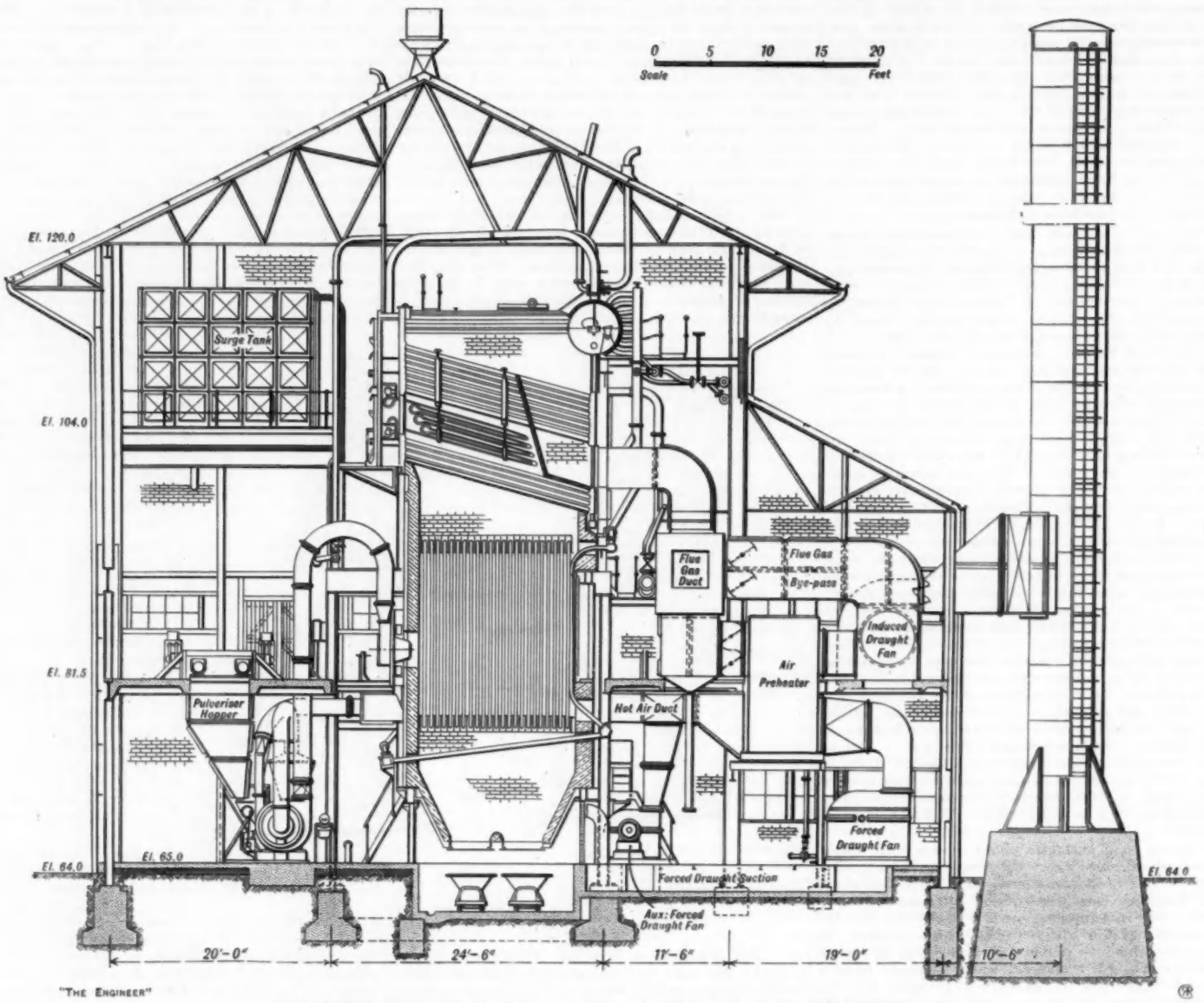


FIG. 9—SECTION THROUGH BOILER HOUSE AT MALIM NAWAR POWER STATION

about 2 miles downstream of Rajahmundry at the "gut," or where the river divides into its branches. The waterway provided was 5000ft., which with a flood depth of 50ft. was anticipated would pass the maximum flood discharge of the river. In high flood the river rises some 23ft. above the anicut crest, little afflux is observed, and above the anicut at Dowleshwaram it forms a vast sheet of water nearly 4 miles across from one high margin to the other; in the live stream a small river steamer, which in still water can make over 8 knots, is hardly able to make headway going up the river, and can only proceed upstream by hugging the margins opposite to that along which the live stream is at the time flowing. The two proposals are shown in broken lines in Fig. 4. They do not represent the actual designs, but indicate the proposed waterway and correct length of training banks. Strong opposition was raised by the Irrigation Authorities to the second design, on the ground that it would cause increased shoaling above the anicut, and also that the afflux required to attain the necessary scour through the bridge might endanger the "flood banks." The bed of the river consists of coarse sand, effective size about 0·03in.; at times shoals of small pebbles are carried down. The controversy was never settled, and the railway bridge was eventually built at Rajahmundry, the waterway extending to the full width of the river from one high margin to the other. The bridge was completed in about 1897–98.

Owing to the coarse quartz variety of the sand bed of the Godavery River above the Dowleshwaram anicut, changes in the river channel are slow; the river, however, continued its set on the right margin towards Kovvur. Fig. 5 shows a survey of the river under the same conditions, taken during the cold weather, 1919–20. The Kovvur Creek has now become the main channel, and the Rajahmundry channel its concomitant creek. The main channel now runs diagonally across the river from Kovvur to Rajahmundry. The piers of the railway bridge at the eastern or Rajahmundry end are carried down to rock, met, as stated above, at 30ft. below low water level, so that danger from excessive scour is avoided, a state not always obtainable in the large rivers of India. Fig. 6 shows cross sections of the river at A B and C D of Fig. 5.

The Perak River Hydro-electric Power Scheme.

No. II.*

MALIM NAWAR STEAM POWER STATION.

A STEAM power plant designed for burning local coal on the pulverised fuel principle has been built close to the main Federated Malay States Railway line at Malim Nawar, some 10 miles south of Batu Gajah, in order to maintain the continuous output of the system during the low-water periods in the Perak River and also to act as a standby and voltage regulating station. With a view to building up the load on the system preparatory to the hydro-electric station being put into service, the Malim Nawar station was erected as early in the construction programme as possible, and began commercial operation in December, 1928.

The station originally contained two 6000-kW turbo-alternators and three boiler units, each with a maximum evaporating capacity of 52,000 lb. per hour, one turbo-alternator and one boiler being regarded as standby plant. The demand for power, however, increased so rapidly that extension of the station became necessary before actual operation was begun. Consequently a further turbo-alternator set of the same capacity as the initial sets and one larger boiler—of 90,000 lb. per hour maximum evaporative capacity—were added. These units were brought into service in July, 1929, and raised the continuous output to 12,000 kW. Fig. 10 shows the general lay-out of the station.

The fuel used for normal running is Rawang lignite, with a high moisture content and a calorific value of about 8500 B.Th.U. per lb. As this coal is liable to spontaneous combustion if stored for more than a few days, a reserve stock of higher grade fuel of about 11,500 B.Th.U. per lb. is kept for emergency use. Cooling water for the condensers is normally obtained from an adjacent stream, the Sungei Plekat, across which a small dam has been built. During the dry season there is insufficient water, so that a further supply has to be diverted through a canal from the Kampar River to the Plekat. In addition, spray ponds are used for cooling the circulating water, which is then returned to the condensers. In Figs. 14 and 15, page 228, the site of the power-house and the state of the work eleven months later are illustrated. Another view of the station substantially completed is given in Fig. 13. Figs. 11 and 12 show the turbine-room and boiler-house interiors, and in Fig. 9 a general section through one of the smaller boiler units is given.

The coal is delivered to the station in trucks, and is discharged into raw coal hoppers situated below the rails. From these hoppers it is carried into the station by means of a drag link conveyor under the bunkers, and an inclined belt conveyor which carries the coal from the bunker pit to the mouthpiece of a coal crusher. After passing the crusher, which reduces it to about 1in. cube, the coal is delivered by means of an elevator, to coal bunkers situated in the roof of the dryer house, from which it is passed through steam-heated dryers capable of reducing the moisture content from 27 to 10 per cent.

Two screw conveyors, one of which is normally a standby, receive the dried coal and convey it to the pulverisers, which, being arranged on the unit system, are adjacent to the fronts of the boilers. Each pulveriser is of the impact type, and has a capacity of 4 tons per hour. The coal is fed automatically into the pulverising chamber, where it comes in contact with a number of rotating steel beaters, which reduce it to a powdered state. The coal dust is carried from the pulveriser to the burner by a current of pre-heated air, passing on the way through a classifier which rejects the coarser particles and returns them to the mill.

The combustion chamber of each boiler is fitted with side and rear water-cooled walls, and a water screen across the bottom to prevent the slagging of the ash. Each of the small boilers is provided with one burner of the turbulent flow type, situated in the front wall, which consists of brickwork only, while the larger unit has two burners of similar design. The four boilers are of the water-tube type, with a single steam and water drum. All are designed for a working pressure of 255 lb. per square inch gauge, and are fitted with superheaters to give a total temperature of 660 deg. Fah.

* No. I. appeared August 22nd.

After leaving the boiler, the combustion gases pass through an air preheater of the rotary type, the elements of which are alternately exposed to the hot gas and the cold air. The reduction in temperature of the gases by the preheater is 350 deg. Fah., while the inlet air is raised from 90 deg. to 450 deg. Fah. Two such units are installed, capable of dealing with the flue gas from the four boilers. The gas, after leaving the preheater, is delivered to an independent stack.

There are two induced draught fans for each stack, one of which is normally a standby. Three forced draught fans—one of which is a spare—and two auxiliary forced draught fans supply air from the atmosphere to the preheaters and the hot air ducting through which this air is led to the pulverisers and burners.

The steam from the boilers passes through two 12in. mains to two receivers in the turbine-house basement, from which it is taken direct to the turbines. These machines, of which there are three, are of the impulse type, having eight stages, and run at 3000 r.p.m. They are arranged for bleeding 7600 lb. of steam per hour at a pressure of 40 lb. per square inch absolute for use in the evaporators and feed-water heaters. Each turbine exhausts to a surface condenser giving a vacuum of 27in. with cooling water at 95 deg. Fah. In order to ensure continuity of operation of the circulating water pumps, in so far as motive power is concerned, a duplicate supply is arranged either from the general service switchboard or on the unit system from a 100 kVA transformer connected to each alternator directly.

The condensate is dealt with on the usual principle, *i.e.*, it is extracted from the condenser by means of a pump and passed through an air ejector to the boiler feed pump suction against the head of a surge tank. Three feed pumps are provided, two of which are motor-driven and one turbine-driven. One pump is normally a standby.

The alternators are direct-coupled to the turbines. They are rated at 6000 kW at 0·8 power factor, 6600 volts, three-phase, 50 periods, and have an overload capacity of 25 per cent. for 2 hours. Closed circuit ventilation is employed, each machine being fitted with an air cooler. When the hydro-electric station is supplying power to the system, one of the alternators at the steam station is required for operation as a synchronous condenser. In consequence, each machine has been arranged for this purpose, and is provided with a starting switch for connecting it to one of the other machines, the two machines being run up to speed together by one of the turbines. The machine operating as a synchronous condenser is uncoupled from its turbine by means of a special disconnecting arrangement provided for the purpose.

Along the side of the turbine-house remote from the boiler-house is the switch annexe, which contains the following apparatus :—

(1) 6600-volt main switchgear, consisting of a

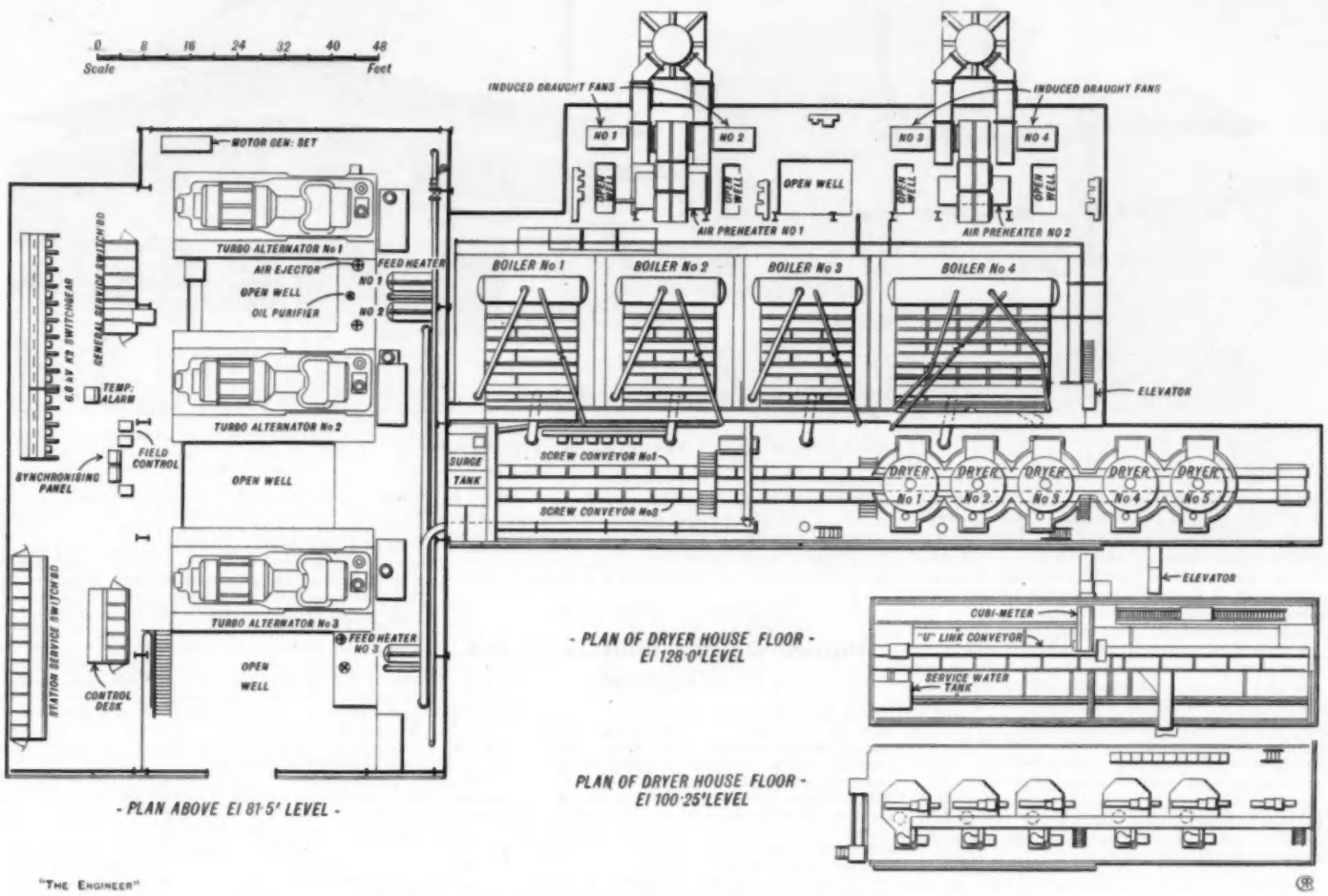


FIG. 10—OUTLINE PLAN OF STEAM POWER STATION AT MALIM NAWAR

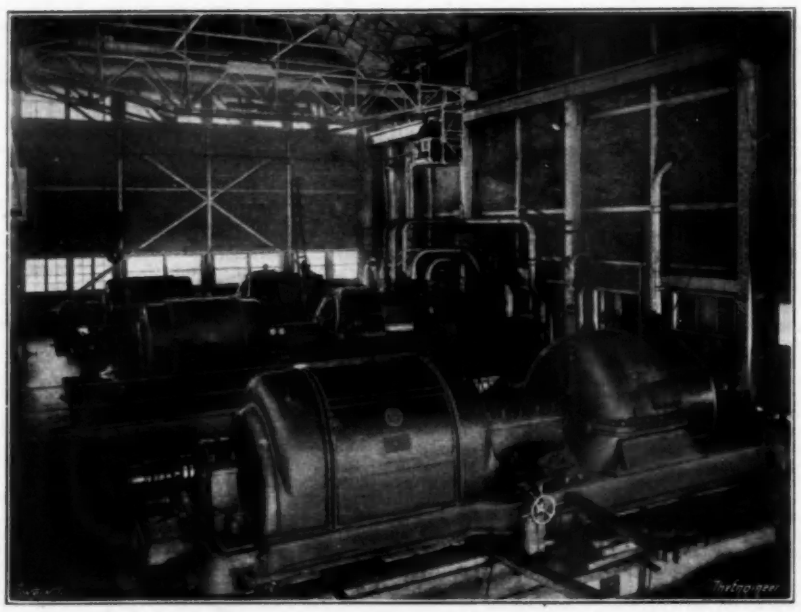


FIG. 11—STEAM TURBINE ROOM

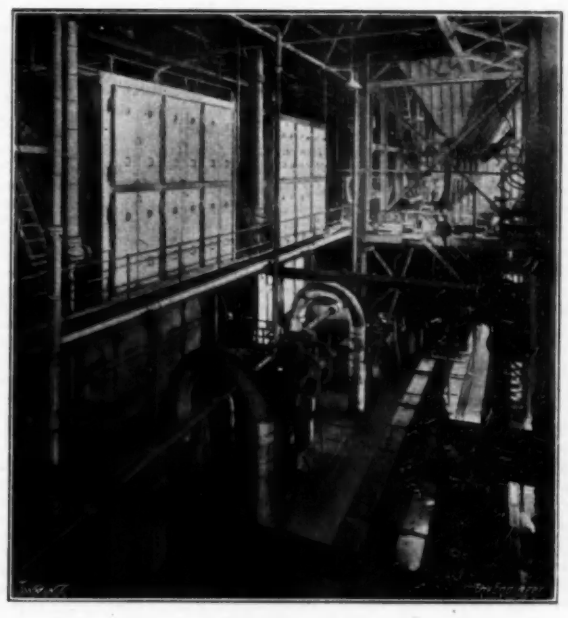


FIG. 12—BOILER HOUSE

THE PERAK RIVER HYDRO-ELECTRIC POWER SCHEME

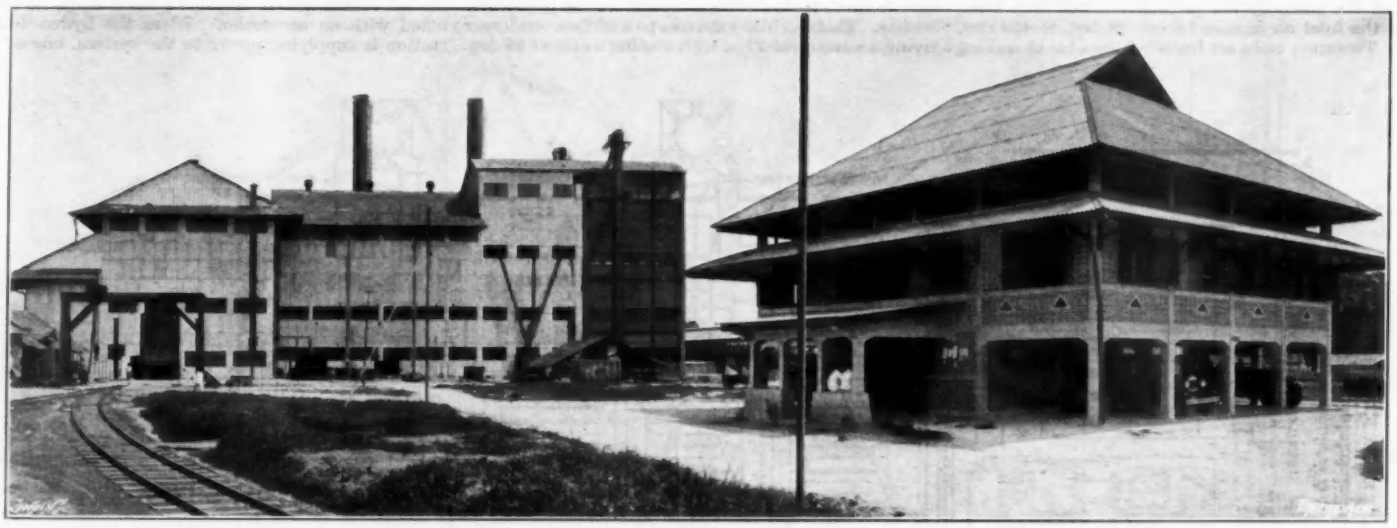


FIG. 13—MALIM NAWAR POWER HOUSE AND OFFICES

thirteen-panel metal-clad compound-filled switchboard with draw-out switches. These switches control the three alternators, four local feeders, the low-tension sides of two step-up transformer banks in the outdoor substation, and the high-tension sides of three station service transformers. The remaining switch is a bus coupler.

(2) A five-panel bench board, controlling the 22 kV and 66 kV switches in the outdoor substation.

(3) A 400-volt station service board. This board is supplied from the low-tension side of the service transformers and controls the feeders to the boiler-house, spray pumps and all auxiliaries.

(4) A general service board controlling the lighting circuits, and the direct-current supply to the battery and control circuits.

(5) The alternator field regulator pillars.

(6) A temperature and alarm board to which are connected the thermo-couples in the alternator and main transformer windings.

A basement below the switch-house contains the three 600 kVA three-phase service transformers, three oil-immersed reactances on the low-tension side of these transformers, and the battery room.

The outdoor switching station is the southern terminus of the main transmission line from Chenderoh and, therefore, contains both 66 kV and 22 kV switchgear. The 66 kV gear consists of a double bus-bar system with line switches and isolators. A bus-coupler switch is provided and the system is connected through a fourth 66 kV switch to the high-tension side of a 66/22 kV transformer bank. This bank is connected to the 22 kV switchgear, which is also a single bus-bar arrangement. A second 66/22 kV bank of similar capacity is now being installed and will operate in parallel with the existing bank. The substation is being extended to include the necessary 66 kV and 22 kV switches and isolators for controlling this second bank. The double line supplying the area south of Malim Nawar and the two step-up banks of transformers fed by the steam-driven plant are connected to the 22 kV bars.

The 66 kV switches are similar to those at Chenderoh. The 22 kV switches are not mounted on rollers, but are supported on a fixed steel framework, tank lowering gear being provided. All these switches are solenoid operated, the control switches being mounted on the bench board in the station switch bay.

The 66/22 kV transformer bank comprises three single-phase units and one spare. They are of the oil-immersed self-cooled type and are delta-connected on the high-tension and star-connected on the low-tension sides. The bank is rated at 7500 kVA and the units are provided with tappings in the high-tension windings to give −5 per cent. As a protection against internal faults, Buchholz relays have been fitted in the pipe between the transformer and the expansion vessel. The two 22/6·6 kV banks are also rated at 7500 kVA each, and are composed of single-phase units, one spare being provided for the two banks. They are, in general, similar to the 66/22 kV banks, but are star-connected on the high-tension and delta-connected on the low-tension sides. The neutrals of all three banks are thus on the 22 kV side, and are earthed through a Petersen coil and parallel resistance as at Chenderoh. The Petersen coil is, in this case, rated at 38·5 kVA.

The arrangement of the station is such that further extensions, bringing the capacity to 18,000 kW, with 6000 kW in reserve, *i.e.*, a total installed capacity of 24,000 kW, can readily be carried out when the demand for power exceeds the present output of the system. With this object, one side of the boiler and turbine-houses has been equipped with temporary walls of asbestos sheeting, which can easily be removed, but the structure and arrangement of the plant will require no alteration or modification when the extension is undertaken.

(To be continued.)

Future Responsibilities of the Engineer.

FOR the Commencement Address, delivered before the Worcester (Massachusetts) Polytechnic Institute, in June last, by Brigadier-General Robert Irwin Rees, who is Vice-President of the American Telephone and Telegraph Company, the speaker chose for his subject "Future Responsibilities of the Engineer." Never in all history was there, he said, a time when working and living conditions were better, or when education, the necessities of life, and even luxury, were so abundantly available. For any one mind to grasp more than a small portion of the rapidly accumulating body of engineering knowledge so basic to our present civilisation is almost impossible.

"Little more than fifty years ago," continued General Rees, "in a period of discovery and invention enriched by the knowledge physical science had uncovered, engineering education was born, to change and uplift the whole tone of American life. All the conveniences of transportation, communication, light, power, and a host of things too numerous to mention, are monuments of the material achievements which have resulted. While we may be mystified by the multiplicity of accomplishments in the world's progress, there will most probably be a quiet and continuing evolution, accompanied by certain powerful social changes. It is inevitable that engineering must change also, because it is an instrument of social as well as of material progress. If engineering is to fulfill its promise and its possible destiny, it must share the responsibility for control of the social consequences which its conquest of material things has created.

"The public admires the spectacular works of the engineer, but too rarely has he been recognised in determining the policies of our great industrial enterprises. It is inevitable, however, that many successful engineers will become executives.

"While no claim is made that engineers are going to usurp all or even a major portion of the positions of management, although this observation reflects the tendency of the times, yet in the future it is quite assured that more of the administrators of business are going to come from the engineering profession. No other education gives more of that kind of training which is so easily adapted to the appreciation and the solution of management problems. While formerly industry looked to the engineering schools for men merely as technologists, expecting them to deal solely with the material things, growth of responsibility placed upon young engineers in industry has brought forward the necessity for their appreciation of the principles of management, economics, and labour relations. But it is not desired to leave the impression that the field for the more purely professional applications of engineering is being restricted in any way. In fact, the field is constantly growing in research, design, and technology.

"Our future industrial life and economic life demand an ever-widening application of engineering knowledge and method, and leave to the young engineer more diversified fields of usefulness than ever before. If engineering education is to realise its fullest values, it will not be restricted to the purely technical development of the profession, but will carry over into other fields that same engineering method of thinking that has brought about our material prosperity.

"These changing demands have influenced engineering education and to-day there are two broad trends in the development of the curricula. One of these is away from devoting too much time to application and specialisation, with a corresponding trend toward a more thorough grounding in the fundamental physical sciences, including mathematics. The other is the realisation that if a young engineer is to take his place as a citizen in the world of men, he must know something of the humanities. The engineering curriculum is to-day being liberalised through more emphasis on English, to develop clear expression, history, economics, and other social sciences, to impress upon the students responsibility in life toward human relationships. Out of engineering education is now being evolved a culture which enables a young man, not only to meet his obligations of future productive usefulness, but also to become an influential member of society and a representative citizen. These new conceptions have enabled you to fit yourselves better for your life's work.

"Many positions are being filled each year by men and women who, lacking formal training, have nevertheless, by hard work and self-development, won the confidence and respect of their fellow workers and are being assigned to leadership over them. In addition to this self-developed group, there is a general need in industry for people who, because of special education, training, and superior personal qualities, are able to do the task at hand better than those of limited preparation.

"Industry tries to select men who it thinks will succeed, and perhaps the standards employed in the selection will give you an insight into the manner in which experienced employers exercise their judgment.

"The first standard is that of character.

"The second is that of adaptability to the spirit and aims of the organisation, including interest in and devotion to the service, willingness to co-operate and to promote co-operation in others, ability to accept the social and economic philosophy underlying the organisation, and personal acceptableness to its present *personnel*.

"The third standard is that of personal capacity. Over half of the work for which college men are employed and developed is primarily administrative in character. Such work calls for men who can think analytically, plan constructively, use written and spoken English convincingly, organise men and facilities, and direct subordinates effectively. The other class of work for which young engineers are sought is staff service involving the use of expert knowledge and technique.

"The fourth standard of judgment is based on past performance. Employers are interested in knowing how well a man performed in his last job. Graduates are not selected for scholarship as such, but weight is given to scholarship as an evidence of definiteness of purpose, capacity for concentration, mental vigour, and ability to put first things first in the midst of distractions.

"I have tried to give you a small conception of what employers in industry are looking for in you as engineering graduates. I wonder if now I can put myself in your place, and see if we can determine the satisfactions which should come to you in the selection of your life's career. Most of you, no doubt, have secured your first position. Let us hope it is one which will satisfy the fundamental motives of your life. Surely it is a modest demand that you have interesting work, an adequate livelihood, and an opportunity for individual recognition. Because of the increasing size of industrial organisations, a large variety of interesting occupations are available in each of them. In making a decision in the choice of a company, one should investigate the history of the organisation, its reputation, its financial strength, its aims, ideals and policies. It is hoped that you have asked some or all of these questions: Is the company progressive? Does it take care of its people? Does it have the type of work in which one is interested? In what capacity would one enter the business? What sort of associates would one have? What would be the compensation and prospects of advancement to a worth-while position of responsibility? You are entitled to know all these things, as they will have a decided effect on your future progress and ultimate success.

"Within my experience and observation, I should like to give you as true a picture as I can of what your experience in industry will be. While in our conscious selection of college graduates we are employing them for future leadership, please let me emphasise the word 'future.' We hope to be able to train you for real leadership in from ten to fifteen years; in fact, we are employing you for that future period rather than for the minor job which we have available for you to-day. But, gentlemen, we want you, from the very beginning, during the whole time that you are going through the grueling grind of monotonous routine and laying the foundations for your future responsibilities, to attack every problem in a thoughtful way; to consider what is the best way, in the light of your educational experience, for doing that job better and improving the technique, no matter how narrow is the work it is your lot first to carry on. We want you, when you come to us, to

relate the little job which is assigned to you to those of your associates and of your superiors, so that you will grow in ever-broadening comprehension. Then, when responsibility comes to you, you will have the power, the vision, the ability, and the capacity, to do your particular job in management better than it has ever been done before. Because of the increasing complexity of our growing modern industries, that is what must be : every job must be done better than it has ever been done before. And when you come to that period, ten or fifteen years hence, when you have gone through your novitiate and emerged into an executive position, you will know how to respond to the heavy demands imposed on you, and be able to solve the serious problems which confront you.

"During all this early period of your career, you will find the engineering method of thinking a constant strength to you, and in increasing measure will the engineering knowledge you have gained in your courses here, be of value. These two combined, knowledge and method, will give you power for progress."

SIXTY YEARS AGO.

WHEN our correspondent in Paris wrote his weekly letter for our issue of September 2nd, 1870, he did not know that before it appeared in print the Emperor and 80,000 of his troops would be surrounded at Sedan, and that on the very day on which his words were published the great surrender would take place. He did not know that the Second Empire had but two more days of existence before it, and that on September 4th the Third Republic, established by a Government of National Defence, was to take its place. Above all, he did not know that on September 19th the Prussians would begin the siege of Paris and that the investment of the capital was to continue until January 30th of the following year. He did know, however, what preparations were being made to receive the enemy, should "a succession of unlooked-for disasters" to the French armies enable the Crown Prince and his troops to force a way towards the capital. Unobstructed by any censorship, he gave us intimate details of the Parisian defences and the steps that had been or were being taken to strengthen them. There had been a panic among the population as news of disaster upon disaster came through from the frontier, but it had subsided then. The preparations for the defence of the capital had given confidence to all, except the most timid. All the roads into Paris had been protected. The smaller gates had been blocked up with masonry pierced with loopholes for riflemen. The principal gates had been provided with bridges over the fosse, and had been strengthened with defensive masonry and external earthworks. The bastions and the forts were bristling with cannon, and swarming with men. The zone lying between the outer forts and the *enceinte continuée* had been evacuated at forty-eight hours' notice, and every building in it was ready to be razed to the ground. Preparations were said to be in hand for flooding the surrounding country by means of the waters of the Marne. The hundred bridges leading to the capital had been mined, and were ready to be blown to pieces at the touch of an electric button. It had even been rumoured that the Bois de Boulogne was to be destroyed, but the report was false, our correspondent said. It was suggested that the best time to pour petroleum over the trees and make a bonfire of the famous plantation would be when the enemy was within it. A flotilla of small iron gunboats had been provided to guard the Seine. The water gates and bridges were protected by means of moored pontoons composed of iron plates and loopholed for riflemen. At the works of Cail et Cie. there was being constructed "a kind of colossal locomotive mitrailleuse, to run on rails, and capable of sending forth a perfect storm of iron." On the Plateau de Gravelle and at St. Maur the Garde Mobile was drilling in immense numbers. The Conservatoire des Arts and other buildings had been converted into ambulance stations. From the surrounding departments food was being collected and stored in the city, and from the United States and other countries large quantities of wheat were being received. Among schemes which it was proposed to carry out was the provision of captive balloons with wires to the ground for observing the enemy's positions. Electric lights, it was planned, would be installed to keep a watch on the enemy's movements at night. The entrances to the sewers were to be closely watched, and arrangements were to be made for stifling any invaders daring to enter the city through them. Our correspondent still seemed disinclined to believe that the Prussians would attempt to approach Paris. In any event, he was sure that if they did, they would not succeed in reducing the city by starving it out in anything under six months. Actually the siege so soon to begin was to last for 4½ months, and hunger was to play a not unimportant part in ending it.

Heavy-Oil Engined Locomotive for Plantation Service.

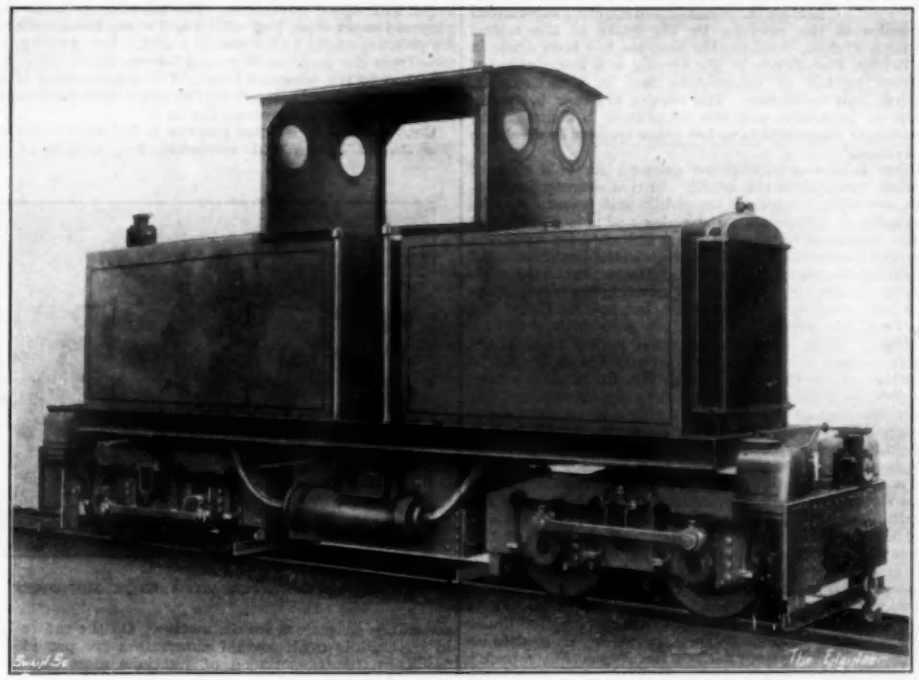
THE locomotive shown in the accompanying engraving has been specially designed and constructed by the Avonside Engine Company, Ltd., of Bristol, for service on plantation work.

The particular engine illustrated is destined for Natal. At present the work for which it is intended is performed by four-wheels coupled steam locomotives, weighing 9½ tons in working order, with cylinders 8¼in. diameter, 12in. stroke, wheels 2ft. diameter, and a pressure of 160 lb. per square inch. These engines have a tractive effort of 4913 lb. at 85 per cent. boiler pressure, and give very satisfactory service on the main lines, which are laid with 30 lb. rails. Their axle loading is, however, too high for the feeder lines which are laid with rails of 16 lb. to 20 lb. per yard, and traction on those sections has hitherto been performed by smaller steam locomotives and by animal power.

The locomotive, which we illustrate, has been designed to give a tractive capacity at least equal to that of the heavier 8¼in. steam locomotives, whilst at the same time being capable of running on feeder lines laid with rails of 16 lb. per yard upwards and of freely negotiating curves of 45ft. radius. It was originally intended to adopt steam operation in conjunction with a totally enclosed engine geared to the wheels, but it was later decided to adopt heavy oil engines, partly to avoid all risk of plantation fires due to spark throwing, but principally in order that the relative advantages of steam and oil engine operation could be put to a practical test under actual operating conditions.

HEAVY-OIL ENGINED NARROW GAUGE LOCOMOTIVE

THE AVONSIDE ENGINE COMPANY, LTD., BRISTOL, ENGINEERS



The locomotive, as will be seen from the engraving, is of the articulated type. The main frame rests upon spherically-seated bogie slides, which are permitted a limited amount of longitudinal play in the bogie centre castings. Spherically-seated, spring-loaded side bearings which are clearly indicated on the illustration are provided. The drawgear, which is of the dead-buffer type provided with rubber shock-absorbing pads, is mounted on the bogies and the bogies are articulated to the centre portion of the frame by a special form of articulated spring drawgear, so that the bogie centres may be relieved of all buffing shocks and drag stresses. The channel portion of the main frame carrying the engine and the three speed and reverse gear-boxes, are also relieved of all stresses, so that there may be no risk of mis-alignment or damage to the engine and transmission gear consequent upon rough usage in service.

The drive is taken from the main engine through an 18in. Wigglesworth disc-type friction clutch to the three speed gear-box, the connecting shaft passing over the reverse gear-box which is arranged on the longitudinal centre line of the locomotive. From the secondary shaft of the reverse gear-box the drive is taken through two universally-jointed cardan shafts to worm gears mounted on the outer axle of each bogie, the bogie wheels being connected by side coupling-rods, following ordinary locomotive practice.

The prime mover is a six-cylinder, high-speed, solid-injection oil engine, supplied by L. Gardner and Sons, Ltd., of Patricroft, Manchester. It has six cylinders, 4¼in. diameter by 6in. stroke, and develops a normal output of 57 B.H.P. at 1000 r.p.m., or 68 H.P. at 1200 r.p.m., and will run up to 1400 r.p.m. for short intermittent periods. It is easily started by hand. All the compression-control levers are first placed in the no-compression position. When the engine is rotated by hand to a fair speed, the compression levers of the first two cylinders are thrown over to full compression, remote control being arranged for to facilitate this. The engine then fires by the heat of compression and runs on two cylinders only, the remaining compression levers being thrown over when the engine is running. We are informed that during tests at the works, no difficulty whatever was experienced in starting by hand from cold, and that the engine performs very satisfactorily, and will take up full load torque at the idling speed, which is about 400 r.p.m., that feature greatly easing the load on the friction clutch under starting conditions.

The cooling of the circulating water is effected by a Reliance-type D.K. 36 radiator, working in series with a 40-gallon capacity circulating water tank.

The three-speed gear-box is designed to give three speeds of 3, 5½ and 8 miles per hour at normal engine speed. The gears are of nickel steel and are picked up by dog clutches operated by a single-control lever through the medium of selectors. The independent reverse gear-box is arranged with sliding gears giving equal speeds in each direction, and is operated from a separate reverse gear. Skefko ball bearings are fitted throughout the three-speed and reverse gear-boxes, except on the final shaft of the reverse gear-box where heavy bronze bearings are employed. The gear-boxes were entirely designed by the technical staff of the Avonside Engine Company, but the actual manufacture of the gear wheels and shafts was carried out by David Brown and Sons, Ltd., of Huddersfield. The universally-jointed cardan shafts connecting the reverse gear secondary shaft to the worm gears on the outer bogie axles were designed and manufactured by the Avonside Engine Company, and gave every satisfaction on test, the locomotive operating freely in top gear on reverse curves of 38ft. radius.

The worm gears on the bogie outer axles have a ratio of 3 : 18, and are totally enclosed in cast steel gear cases. Timken taper roller and ball bearings are fitted. The worm reduction gears and cases were designed and manufactured by Bostock and Bramley, of Reddish, Manchester, the worms being of their well-known enveloping type.

The leading dimensions of the locomotive are as follows :

Gauge	2ft.
Type	Double bogie articulated
Wheels, diameter	2ft.
Bogie wheel base	3ft.
Total wheel base	15ft.
Engine, six-cylinder heavy-oil	57 H.P. at 1000 r.p.m. 68 H.P. at 1200 r.p.m.
Speeds : 3–5½ and 8 m.p.h. in either direction at normal engine speed	
Rated tractive effort at—	
3 m.p.h.	5350 lb.
5½ m.p.h.	2920 lb.
8 m.p.h.	2000 lb.
Fuel tank capacity	40 gallons
Water tank capacity	40 gallons
Weight in working order—	
Leading bogie, outer axle	2·7 tons
Leading bogie, inner axle	2·55 tons
Trailing inner axle	2·525 tons
Trailing outer axle	2·675 tons
Total	10·45 tons
Extreme width	4ft. 9in.
Extreme height	10ft. 1in.
Length over buffer beams	18ft. 7¼in.
Minimum designed curve	40ft. rds.
Minimum recommended weight of rail	16 lb. per yard

On test the locomotive is reported as having performed exceptionally well, a load of 15 tons, made up of pig iron in ordinary tipping trucks, being hauled through reverse curves of 40ft. radius, and a curve of 45ft. radius, combined with a gradient of 1 in 50 in top gear, indicating a tractive effort well above the nominal rating. The flexibility of the engine is described as "remarkable," the locomotive starting the 15-ton load in top gear on the combined gradient and curve, with the engine running at idling speed only.

The flexibility of the articulation and the frames suspension was also found to be excellent, the bogies freely adopting themselves to all irregularities of the track, which consisted of portable sections of 18 lb. rails, a large portion of the test track being merely laid on the ground and across existing standard gauge tracks and not ballasted in any way.

A NEW method for the detection of tin is described by H. Meissner ("Z. anal. Chem.," 1930, 80, 247–252), and is quoted in *The Analyst*. The substance or solution to be tested is treated in a porcelain dish with a liberal amount of strong hydrochloric acid and a few small pieces of rod zinc. The mixture is at once stirred with a test tube containing cold water, and the immersed part then held in a colourless Bunsen burner flame. A vivid blue outer flame is evidence of the presence of tin. The test can be repeated several times with the same solution. A preliminary attempt is made to account for the reaction. It was ascertained that chloride iron must be present for the production of the blue colour. The substitution of sulphuric for hydrochloric acid causes the appearance of a reddish-violet flame. The present inference is that the formation of traces of tin hydride or a chlorine substitution product, *e.g.*, $SnHCl_3$, is the cause of the coloration.

L.M.S. Railway Telegraphs.

FOLLOWING the appointment in 1927 by the Postmaster-General of a Committee to report on the inland telegraph service and to examine the possibility of effecting substantial economies in the working by the State of the inland telegraph system, considerable progress has been made in the British Post Office in the testing and installation of different models of teleprinters and in standardising, training, and operating. The results are now becoming apparent, generally, and the teleprinter is claiming the attention of telegraphists as few other systems or machines have done.

There is now a widespread demand for this class of machine throughout the world. In this country installations are being completed on public and private circuits as rapidly as apparatus can be obtained; in the United States thousands of sets are being absorbed by American telegraph companies annually; while in the Dominions and in France, Germany, Holland, and Denmark, considerable activity is also in evidence. Various types of printers have been used by the Post Office, but in 1924 Creed and Co., Ltd., of Croydon, entered the field with a British machine. Trials over an extended period took place, and as a result of continuous improvements in design the operation of the Creed teleprinter No. 3A reached a high standard of efficiency. When originally introduced, the teleprinter was so arranged that only one message could be signalled at a time in either direction, the characters transmitted being recorded on a local tape as well as at the distant station. Two machines, or one complete machine and a separate printer unit, had to be provided at each office for duplex operation, or the signalling of telegrams simultaneously in both directions, an arrangement which consideration of space and cost rendered unacceptable. It was ultimately found, however, that by a simple alteration in the connections, the transmitter and printer could be operated separately at the expense of the local record, which was not required, and one machine was made to provide for simultaneous transmission and reception under duplex conditions. This stage represented a definite advance in development as the traffic-carrying capacity of each machine is practically doubled with completely satisfactory results. The circuit on which the machines were first installed between the General Post Office and

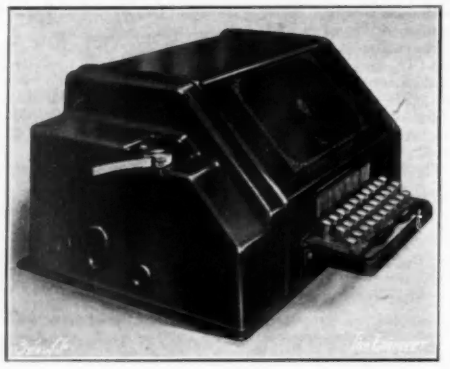


FIG. 1—TELEPRINTER

Croydon, did not exceed 15 miles in length, but subsequently a trial took place between the General Post Office and Carlisle, a distance of approximately 300 miles. The results obtained were satisfactory and impetus was again imparted to development. Concurrently, improved acquaintance with the keyboard made operators confident and efficient. Hourly outputs of seventy, eighty, and ninety telegrams in one direction or the other were being obtained on the trial circuits. Since 1923 the Post Office has installed no fewer than 700 teleprinters.

Last year the chief general superintendent after consultation with the telegraph engineer decided to adopt teleprinters on circuits between the principal stations on the L.M.S. railway company's line where the flow of telegrams—minimum 200—between 10 a.m. and 6 p.m. would justify the expenditure, and these machines have been installed in the following telegraph offices for the circuits indicated :—

Euston.	St. Pancras.	Birmingham.
Euston–Derby.	St. Pancras–Derby.	Birmingham–Crewe.
Euston–Crewe.	St. Pancras–G.P.O.	Birmingham–Derby.
Euston–Manchester.		
Derby.	Sheffield.	Leeds.
Derby–Euston.	Sheffield–Derby.	Leeds–Derby.
Derby–St. Pancras.		
Derby–Birmingham.		
Derby–Crewe.		
Derby–Manchester.		
Derby–Leeds.		
Derby–Sheffield.		
Derby–Derby P.O.		
Manchester.		
Manchester–Derby.		
Manchester–Euston.		
Manchester–Crewe.		

Morse sounders and keys are also provided with each circuit to be switched in as required outside the hours of 10 a.m. to 6 p.m. Additional circuits under consideration are :—Derby – Nottingham, Derby – Leicester, Crewe – Chester, Euston–Birmingham. The type of instrument in use is shown in Figs. 1 and 2. This apparatus uses the 5-unit code, each letter of which is formed by a combination of five signals of equal length, which may be differentiated either by reversals of polarity or by a rise from zero to positive or negative. Each combination of signals is preceded by a "start" and followed by a "stop" signal, these signals being necessary to operate the printer, which starts and stops for each letter printed, and for this reason comes under the heading of "start-stop" printers.

Teleprinters are usually set to work at a speed of sixty-six words per minute, and in practice it is found that a skilful operator can transmit for long periods at a speed of fifty to sixty words per minute; an average operator can easily maintain forty to fifty words per minute. The teleprinter can be worked with double or single current, simplex or duplex, on any wire with earth return or a copper loop. The instruments are driven by electric motors fitted with speed governors. The teleprinters print on a gummed paper tape, ½in. wide, a reel of tap being sufficient for printing about 16,000 words; and, after printing, the tape from the machine is passed over a water wheel and attached to the telegram form. The arrangement of the type keyboard, including an outline of the fingering adopted in touch typing, is shown at Fig. 3.

Conventional typewriter practice is followed in the disposition of letters and numerals, but certain of the

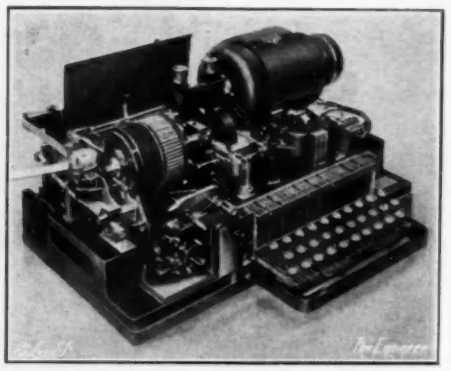


FIG. 2—TELEPRINTER WITH CASE REMOVED

secondary characters are distinctive. On the centre keys in the middle bank several numerators are provided to facilitate the transmission of fractions most commonly used. The denominator is produced by printing an appropriate numeral immediately after the combined numerator and oblique stroke. By this means a considerable range of fractions can be expressed in suitable form with a minimum amount of signalling. The symbol on the key at the extreme left of the bottom bank is used to indicate an "erasure," while that on the extreme right is operated for the "end of message" signal. A departure from typewriter design is the provision of two space bars. The function of these space bars is two-fold. Not only do they provide the spacing between words or groups, but they also determine whether the characters to be printed shall be those on the letter shift or the figure shift. The teleprinter circuits have now had a thorough trial, and although there have been unforeseen difficulties the staff of the Signal and Telegraph Engineer is to be congratulated on the good results now being obtained.

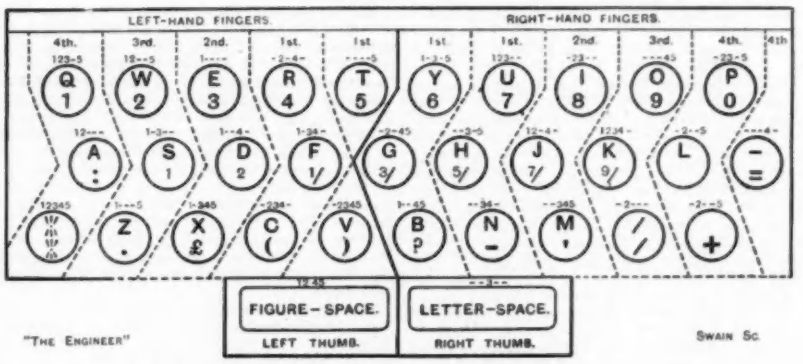


FIG. 3—ARRANGEMENT OF KEYBOARD

An output of 800 messages between 10 a.m. and 6 p.m. on duplex circuits and 400 on simplex circuits has been obtained, and in an hour's trial 215 were dealt with by duplex and 90 simplex without any difficulty. Between 400 and 500 telegrams can be disposed of daily, working simplex, as against an average of 150 per day on railway telegraph circuits of all types. There are no longer batches

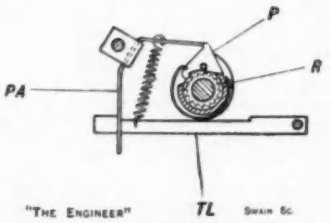


FIG. 4—CLUTCH MECHANISM

of telegrams waiting to be dealt with between 5 p.m. and 6 p.m. and at 12 noon on Saturdays. Telegrams are delivered to their destination before the closing of offices, with the result that the company's business is now conducted more expeditiously and a considerable decrease in repeat telegrams has followed. Although female operators are engaged on this work generally, the male staff has taken a keen interest in the machines, and excellent results are being obtained from men of forty years of age and upwards. The operation is less arduous than that of Morse or other telegraph circuits, and except for the timing in or out and the clerk's signature, no writing is necessary. The interest shown by the chief clerks and operators generally has largely contributed to the success of this important innovation in railway telegraphs, the L.M. and S.R. Company being the first in the field to adopt teleprinters of this type for railway circuits.

As shown in Fig. 2, both the transmitter and printer mechanism on the model 3A are mounted on the same base and are driven by the same motor, which drives through gearing a spindle and clutch to operate the printer and another spindle and clutch to operate the transmitter. The operations are carried out by a cam under the control of the keybars and this cam is operated by means of a single revolution clutch—Fig. 4. The cam is supported on a spindle on which there are ratchet teeth R and attached to the cam are two pawls P, which are normally held out of engagement by the abutment P A. When the trip lever T L is drawn to the right by the depression of any key, it engages the pawl abutment P A and withdraws it from engagement with the pawls P. When this occurs the pawl spring forces the pawls into engagement with the ratchet teeth R, and the cam then revolves with the spindle. As the cam revolves an excentric path on its circumference pushes down the lever T L until it is out of engagement with the pawl abutment P A, which is then returned to its original position by its spring, and is ready to intercept the pawls at the end of one revolution. The pawl extremities, striking the pawl abutment, withdraws them from the ratchet teeth and the cam remains stationary until the trip lever, which is restored to its normal position on releasing the key, is again operated. The cam is retained in its stationary position by a retaining lever—not shown—which is held in a notch in the periphery of the cam by means of a spring, which is sufficiently strong to hold the cam steady, but allows it to revolve when the pawls are engaged.

As will be seen from Fig. 5, all the keys—as indicated, for example, at K B—are held in racks and immediately under them are the combination bars C B. A projection on each key rests on a trip bar T B, which runs the whole length of the keyboard and engages with a lever L, which has its other end attached to the cam trip lever T L—Fig. 4—and whenever a key is depressed it presses down the trip bar T B and moves the trip lever T L to the right and lifts the pawl abutment, so as to allow the cam to make one revolution. The combination bars C B have springs attached to them, and tend to pull them to the right, but are normally held with their slots under the keybars K B by means of a lever R B operated by the cam. When a keybar is depressed, it enters one of the slots formed in the combination bars, and at the same time depresses the trip bar T B, causing the cam to revolve, the combination bars being cut with slots or having projections left on them, according to the code, which when a key is depressed prevent any bar which has a projection on it corresponding to that keybar from being pulled to the right.

The cam has six tracks above which are the ends of six selecting levers. The selecting levers S L—Fig. 7—lie over the cam C, which, as it revolves, allows the levers S L to drop for a period equal to the duration of a signal. The right-hand ends of the levers S L lie over the ends of the combination bars, so that when a combination bar is held to the left by a keybar it will prevent its corresponding selecting lever from dropping when the cam revolves. The other ends of the selecting levers S L lie in front of one end of the contact lever C L, the other end of this lever being slotted and the contact blade T lies in this slot. Normally, the lever C L is held by a spring, so that the contact blade T bears against the top contact screw, but when a selecting lever is allowed to drop it strikes the contact lever and forces the contact blade against the lower contact. Thus it will be seen that as the cam revolves certain selecting bars are allowed to drop according to the position of the combination bars C B, and in turn these selecting levers strike the contact lever C L and operate the contact blade which is connected to the line. Signals corresponding to those set up by the combination bars C B are therefore transmitted. There are five combination bars and six selecting levers, the sixth selecting lever, which is not under the control of a combination bar, being used to send out the "start" and "stop" impulses. The cam track on which the sixth selecting lever rides is cut so that after the transmission of the fifth signal impulse, the flat in the track reaches the selecting lever, which drops. The tail of the selecting lever bears against the contact lever C L and carries the contact blade T over to the lower or marking contact, and the cam then comes to rest. At the beginning of each revolution and before the signals are transmitted, the sixth selecting lever is pushed up by the cam and allows the contact blade T to return to the upper or spacing contact. For each revolution of the cam—that is, for each letter transmitted—the sequence of the impulses sent to the line is, first, a spacing impulse, then the five signal impulses, and finally a marking impulse, the extra impulses being used to start and stop the distant selecting mechanism.

When a keybar K B—Fig. 5—is depressed, it enters into the slot formed in the combination bars C B, depresses the trip bar T B and releases the cam pawl P—Fig. 4.

The cam then commences to revolve and releases the combination bars C B—Fig. 5—according to the signal selected by the keybar. One or more of these bars may be pulled to the right, so that they do not obstruct the selecting levers S L—Fig. 7—but other bars which have projections will rest against the keybar instead of moving. As the cam continues to revolve, it allows the first selecting lever to rise, moving in turn the contact lever C L and forcing the contact blade against the upper contact screw. The cam allows the contact lever to hold the blade in position for the correct time, and then returns to its normal position. The cam then allows the second selecting lever

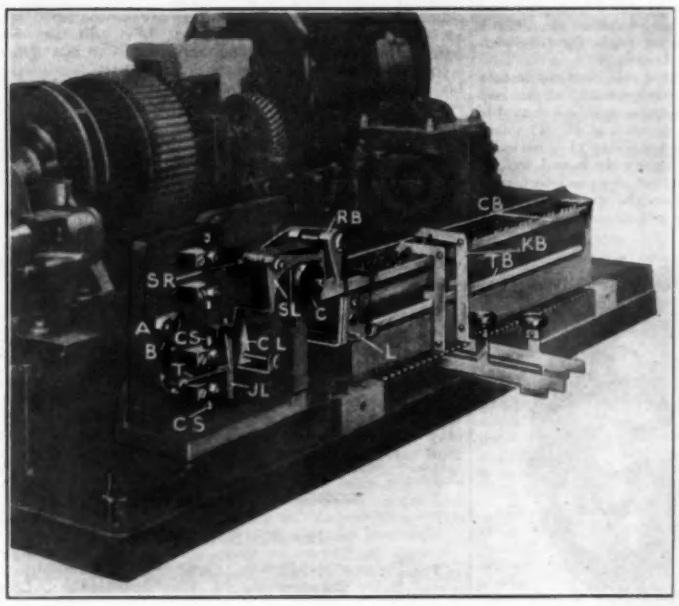


FIG. 5—TRANSMITTER MECHANISM

to drop, and so on for the five levers, which, in turn, operate the contact lever as required, and then return the combination bars to their normal position. The pawl abutment, P A—Fig. 4—having moved into position as previously described, then withdraws the pawls from the ratchet teeth, and the cam comes to rest, and as the pawl abutment is moved into position by the cam, this occurs even if the keybar is kept depressed.

A keyboard locking device is fitted to prevent another key being depressed while one is already down and to prevent the key rising until the signal has been transmitted. The general arrangement of this locking device is shown in Fig. 8, where it will be seen that the locking is effected by two bars L B_1 and L B_2. The former is situated behind the keybars, and is operated by the trip bar T B—Fig. 5—through the medium of a spring. Whenever the trip bar is depressed by a key it carries with it the lever B, thus permitting the locking bar L B_1 to come forward under the influence of the spring operating through the lever C, which is attached to the shaft L B_1, and in its forward position the edge of L B_1 lies under the ends of all the keybars which have not been depressed and prevents their depression until the key originally depressed is released. The second locking bar is similar to the combination bars L B_1, but instead of having a combination of projections, it has a whole series corresponding to the number of keybars. These projections terminate in a right-angled point somewhat similar

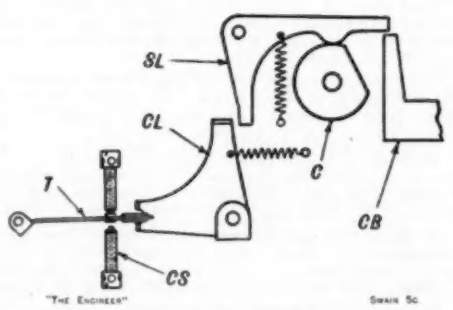


FIG. 7—CAM AND LEVER MECHANISM

to an inverted L, and each keybar has a hole with which this right-angled projection can engage.

When the cam commences to revolve and the combination bars are released, this locking bar is also released and is pulled to the right by its spring, the point of one of the projections engaging in the hole of the depressed keybar, and preventing it rising until all five selecting impulses have been transmitted. Although the functions of the two locking bars appear at first sight to be similar, it is to be noted that the first bar L B_1 is operated by the trip bar and released by it so that it only prevents another key being depressed while the finger remains on the depressed key, while the second bar is cam controlled, and carries on the locking from the first bar until the end of the signal, irrespective of the time the finger remains on the key.

The line signals are received by a polarised relay which controls a device called the mechanical relay by means of a link, the purpose of this mechanical relay being to operate the selecting blade and clutch mechanism, which requires rather more power than is obtainable from the first relay unless a heavy line current is used. Carried on a spindle driven by the electric motor is a detent piece D—Fig. 6—held by a spring against the face of a revolving drum. Normally, this detent would revolve, but it is held in one of two positions by the lever L, which is controlled by the link of the line relay, and thus forms an escapement allowing the detent piece to revolve half a revolution corresponding to each movement of the relay. Attached to the detent is an excentric portion, which controls a rod H directly coupled to the selecting mechanism and clutch, so that a movement of the relay will operate the lever L and allow the detent D to make half a revolution, and thus operate the rod H which, in turn,

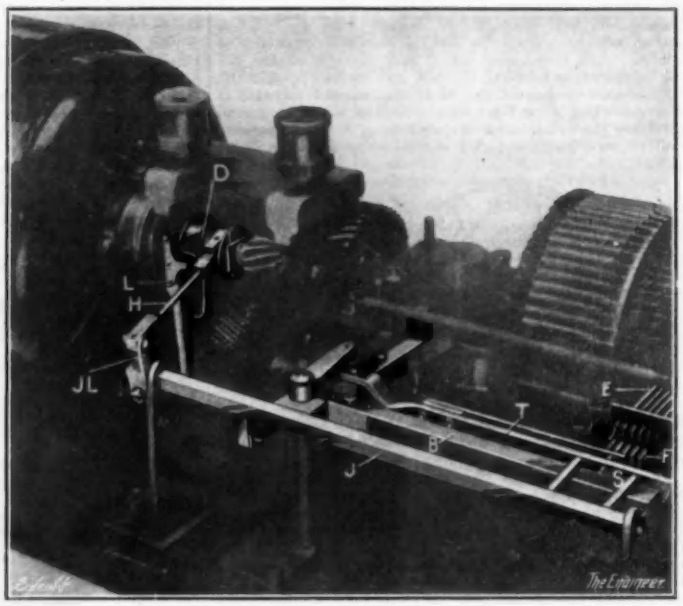


FIG. 6—MECHANICAL RELAY

operates the mechanism of the printer, a diagrammatic view of which is given in Fig. 9. There are five combination combs K having extension pieces E, and immediately in front of these extension pieces are selecting figures F, which are also shown in Fig. 6. There are five combination discs and five fingers F. Each finger can operate a comb and the five combs are mounted side by side on a drum upon which they are permitted to turn a fraction of an inch. Each of these combination combs is slotted on its edge with a different arrangement of slots, and can be made to occupy one of two positions, one of which in combination with other selected combs opens two longitudinal slots in the whole series of five combs.

As there are only thirty-two possible combinations of the five-unit code, the numerals and other special characters are operated by the same combination as that employed for the letters, the change being accomplished by a signal called the "figure shift," whilst the change from figures to letters is accomplished by a signal called the "letter shift." In addition to the five combs on the body of the printer, there is a sixth comb called the "shift comb," which is actuated by two bell-cranks corresponding to the shifts which move it into one of two possible positions, so as to close one set of slots and open another. Thus when the signal corresponding to the letter E is set up on the combs two avenues are open, one corresponding to the letter E and the other to the figure 3, which is the secondary character on the E key, and the position of the shift key determines which shall operate. Passing through the axis of the drum is a spindle which continually rotates the type head and stop through a friction clutch. When the selected combs open a longitudinal slot and admit a bell-crank, the outer end of the latter is projected in the path of the type head stop, thus momentarily arresting the rotating type head and causing the clutch to slip, and a hammer actuated when the type head is at rest strikes the back of the type directly opposite the paper and records the impression. Opposite the selector fingers is

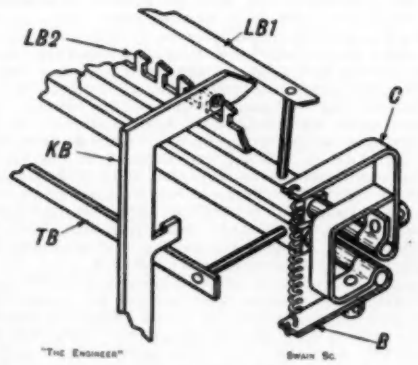


FIG. 8—LOCKING DEVICE

the striker pin S, which is carried in a traversing link T, operated by the cam C, and the striker pin can be pushed forward by the striker blade B.

The operations of the printer are performed by the cam C—Fig. 10—which has five tracks, and is operated by a single-revolution clutch supported on a spindle on which there are ratchet teeth, as shown. Attached to the cam are two pawls P, which are normally held out of engagement by the pawl I—Fig. 9. If the detent is withdrawn the pawl spring forces the pawls into engagement with the ratchet teeth and the cam will then revolve, and if the detent is then replaced before the end of the revolution the pawl extremities will strike the detent and withdraw them from the ratchet teeth, this pawl detent being operated by the trip shaft J—Fig. 9. Track 1 of the cam operates the lever Q, which lifts the selector fingers up at the required time, and then returns them to their zero position. Track 2 operates the bell-crank lifting lever, which lifts the bell-cranks and permits the "reshuffle" of the combs; and track 3 controls the traversing bar T, which carries the striker pin, the normal position of this pin being opposite the middle selecting finger. When the cam revolves the traversing bar carries the selector pin first to the left until it is opposite the first selecting finger, and then to the right until the last selecting figure is reached, and finally returns to the control position. Track 4 operates by means of the lever N, the type hammer, which prints the selected character; whilst track 5 controls the striker blade B, and is cut with five steps which cause the blade to make five forward movements, and is so timed that these movements take place at the time that the striker pin is opposite each successive selector finger. At the end of the cam there is a retaining notch, into which the end of the retaining lever drops, and this is so arranged that at the end of a revolution when the detent I withdraws the pawls from engagement with the ratchet teeth, the retaining lever drops into this notch and pre-

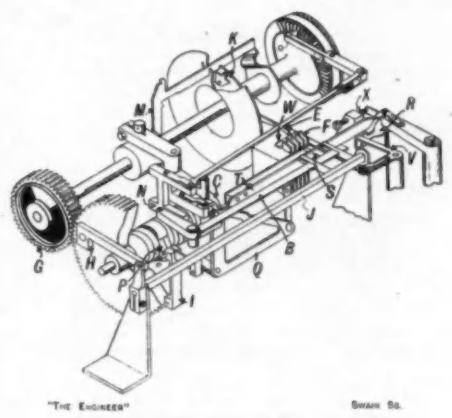


FIG. 9—PRINTER MECHANISM

vents the cam moving forward under the thrust of the pawl springs.

The finger resetting mechanism is controlled by the traversing bar T, the normal position of which is shown in Fig. 9, with the end of the resetting lever V in engagement with the resetting bell crank R. As the traversing link moves to the left the lever R pushes against the end of the lever V and moves it to such an extent that the resetting link W carries the selector fingers out of engagement with the combination comb extensions. Before the traversing bar reaches the end of its stroke, however, the other extremity of the lever R strikes the abutment screw X, which throws the end of the lever R out of engagement with V, which, having no support, is carried to the right by the spring and thrusts the resetting lever W in a backward direction, so as to leave the selector fingers clear for the combination to be set. As the traversing bar moves to the right, the lever R is carried with it, so that eventually its extremity falls behind lever V again.

Seven impulses are employed. The first is always a spacing impulse, and its function is to operate the pawl detent and to start the cam revolving, whilst the last unit is always marking, and its function is to return the detent and withdraw the pawls out of engagement with the ratchet, thus arresting the cam. The intermediate five impulses may be marking or spacing, and if marking the striker

blade will be in its upper position in line with the striker pin, and if spacing it will be in its lower position and will pass under the pin.

Assuming that the letter Y is being transmitted, the combination is: spacing (start), marking, spacing, marking, spacing, marking, marking (stop). The first spacing impulse moves the relay armature to the left and this, by means of the link, moves the detent lever L—Fig. 6—to the left, thus releasing the detent piece, which, driven by the friction clutch, will make half a revolution and be arrested on the other side of the lever L. In making this half revolution the excentric on the detent spindle will operate the lever H, causing the trip shaft to withdraw the detent out of engagement with the pawls by means of the link. Owing to the pressure of the pawl spring, one of these pawls will immediately engage with one of the ratchet teeth on the spindle and the cam will commence to revolve. The traversing bar T carrying the striker pin will immediately move to the left and arrive opposite the first selector finger at the time the second impulse is received. The second impulse, which is a marking one, will move the relay armature, returning it to its marking position, and this, through the clutch and detent, will set

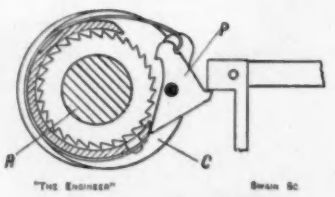


FIG. 10—CAM MECHANISM

the striker bar in its upper position, where, as it is in line with the pin, strikes forward the selector finger as it is moved by the cam.

The next impulse is spacing, and the relay armature moves over to the right, and this re-closes the detent again and sets the striker bar in its lower position. The striker pin is now opposite the second finger, but as the striker bar is in its lower position, when it is moved forward it misses the striker pin and causes no movement to the selector finger. The next impulse, which is a marking one, causes the striker pin to push forward the third selector finger, and so on until the combination has been set up on the selector fingers. The cam track No. 1 then operates the lever Q—Fig. 9—which lifts the selector combs to their upper positions, the bell cranks having first been raised to permit this movement and then dropped to pick up the new selection. The last impulse, which is always a marking one, places the pawl detent I in its normal position, the pawls being withdrawn and the cam comes to rest. There is one clear "avenue" across the combs corresponding to the letter set up, and that allows the corresponding bell-crank to drop lower than any of the others. This bell-crank also acts as a locking bar for the combs. The selected letter is not printed until the

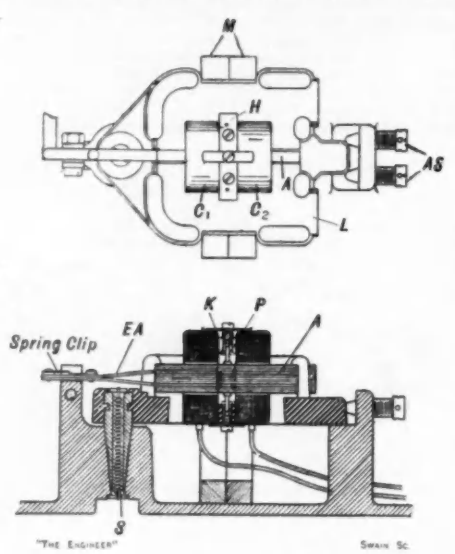


FIG. 11—ARRANGEMENT OF RELAY

next revolution of the cam—that is to say, it is printed while the next letter is being set up on the selector fingers,

The relay, which is shown in Fig. 11, consists of two laminated pole pieces L supported between the poles of two permanent magnets M. The armature A is pivoted in the centre of two pole pieces, as shown at P, and surrounding it are two coils C_1 and C_2. The relay is attached to the base of the machine by a conical pivot held down by a spring S, and at the opposite end there are adjusting screws A S. The pivot bearings have a small oil well, which contains sufficient oil to lubricate the pivot for about twelve months, whilst lubrication at the top pivot can be effected by removing the screw which holds the clip K in position. The armature coils can easily be removed by first removing the armature pivot housing H.

The teleprinter models 3A and 3R, which is a tape receiver unit, are primarily intended for double-circuit operation, which means that the marking and spacing impulses are differentiated by a reversal of polarity. On short lines, however, it is sometimes advantageous to employ single-current closed circuit operation, and in this case the marking and spacing impulses are differentiated by a rise from zero to a predetermined polarity. During the no-current periods the armature of the relay is returned to the spacing stop by means of a spring. A unit known as the adjusting screw bracket is fixed to the relay armature stop casing. It consists of a spring which is attached to the armature, and the tension of the spring can be varied by means of a screw. For single-current operation the send-receive switch on the transmitting unit model 3A is short circuited by a strap provided for that purpose. The send receive switch is an automatic switch, arranged so that the line which is normally connected to the relay is automatically connected to the transmitter contact tongue during the transmission of a signal. It is shown in Fig. 5 at S R and consists of a contact blade operated by the cam and moves between two contact screws. When the transmitter is at rest the blade lies against the lower contact screw and connects the line to the printer relay, but immediately the transmitting cam commences to revolve the contact blade is moved upwards against the top contact screw and connects the line to the transmitter tongue. For duplex and single-current operation it is necessary to short circuit this device, and for this purpose a small brass strap is provided to connect terminals A and B—Fig. 5.

The centrifugal governor used for direct-current motors is shown in Fig. 12, where S is a spring secured at one end to an anchor B and attached at the other end to a movable arm A carrying a weight which is pivoted at P. The arm A has a contact at one end and is arranged to play between the contact C and the stop D. The spring S and weight arm A are calibrated to such values that at a predetermined speed the centrifugal force acting on the weight arm will overcome the spring and allow the arm to move outwards,

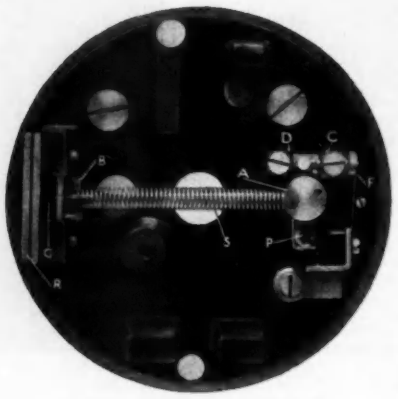


FIG. 12—MOTOR GOVERNOR

and for governing shunt-wound direct-current motors the contacts should be opened until the governing speed is reached. A resistance is connected in series with the shunt coil of the motor and causes the machine to run at a speed above normal, but the governor is arranged to short circuit this resistance, thus causing the motor to run at the correct speed. When the motor is at rest the weight arm A is held against the stop D, but immediately it starts to revolve and the desired speed is reached, the arm A flies outwards and strikes the contact C, thus short circuiting the resistance in the field circuit and causing the speed to drop. Immediately this happens the arm A is pulled back by the spring, thus opening the contacts and causing the resistance to be re-inserted in the field circuit and the speed to rise again. As this action takes place very rapidly, an average speed is maintained corresponding to the setting of the spring and weight arm. A contact F mounted on a spring arm short circuits the governing resistance at starting, so that the motor starts with full field, but immediately the motor commences to pick up speed the arm flies off under the action of centrifugal force and allows the governing resistance to come into play.

Another piece of mechanism which we scarcely need describe is the auto starter, which is arranged to start the motor of the machine on the receipt of the first signal and to stop it again should no signals be received for a lapse of about thirty seconds.

SKYSCRAPERS.

UNDER the auspices of the Technical Bureau for the Utilisation of Steel, Mr. E. Pistor, the treasurer of the American Institute of Steel Construction of New York, recently gave an address at the Salle Iéna, in Paris, on the economy of the American skyscraper.

First of all, the speaker traced the history of the metallic construction of skyscrapers, showing what a decisive part steel played in the rapid erection of large buildings in America. He explained that steel constituted the framework bearing the weight of the building; that weight had formerly been borne by the walls, which were now only screens against inclement weather. Mr. Pistor then referred to the speed with which the construction of skyscrapers had developed in America. Whereas fifty years ago that kind of building was unknown in the United States, there were to-day more than 4778 of them—2479 of which were at New York—having ten stories and over, 372 of the buildings—188 at New York—having at least twenty stories. The other towns possessing over 100 buildings with at least ten stories were Chicago, Los Angeles, Detroit, Philadelphia, and Boston.

The speaker then dealt with the objections to skyscrapers, and said that allowances must be made for initial errors that gave them a bizarre, and even monstrous, appearance. In this kind of architecture, he said, every style had been tried; from the "box with windows" to the decorative building. In Paris the buildings harmonised marvellously. But, Mr. Pistor continued, an æsthetic result would have been reached in the United States if the regulations had been stricter and curbed individual fancies. Methodic ensemble projects were now being discussed at New York, and the Rockefeller city project provided for the construction of blocks of buildings, all of which would be harmoniously grouped. Finally, Mr. Pistor exhibited a film which showed that, as a consequence of standardisation, a skyscraper 225 m. high and consisting of thirty stories, could be erected in ninety-three days.

UMTATA FALLS HYDRO-ELECTRIC PLANT.

IN the first stage, Umtata, in South Africa, was dependent upon Diesel engines as prime movers in its electricity undertaking, and with these and the handicap of expensive fuel, development could only reach a certain limit. The second stage saw the installation of an automatic hydro-electric plant of 100 kW rating, 3 miles from the town on the Umtata Falls. This development was accompanied by revised tariffs and a continuous supply, with the result that in less than two years the power available has all been taken up by consumers. It now becomes necessary, according to the *South African Engineer*, to expand a step further, and tenders are accordingly being invited for a 400 kW hydraulic turbine and alternator with automatic control. The new set will be installed at a point 8 miles further down the river, and the pressure will be stepped up to 11,000 volts for transmission to the central sub-station. The present supply from the Falls is transmitted at 3300 volts.

The new plant will operate on 150ft. net head and a set operating at 1000 r.p.m. is specified, the electric end to be rated at 535 kVA. This new plant will be required to operate in parallel with the 100-kW hydro-electric unit, and with the two 60-kW stand-by Diesel sets in town. Control will be by pilot wires from town, as with the first hydro plant. The output will be stepped down to 3300 volts for local reticulation to street transformers, the ultimate supply to consumers being given at 380/220 four-wire, three-phase.

The specification for the new plant calls for alternative offers for a generator with a rating of 200 kW, there being evidently some doubts about taking as big a step forwards as is involved by installing 400 kW right away. One may assume, however, that the cost of the larger plant, per kilowatt installed, will be so much more attractive and reasonable that it will duly be chosen. One may then look forward to Umtata becoming one of the most completely electrified communities in the country.

BOOKS RECEIVED.

The Commodity Markets. Compiled and issued by the Swiss Bank Corporation, 99, Gresham-street, London, E.C. 2.

Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories). 1928. Canada: Department of Mines.

Economic Yugoslavia. Edited by the Office for Foreign Trade, at the Ministry of Commerce and Industry, Belgrade.

Transactions of the Institution of Civil Engineers of Ireland. Vol. LV. Dublin: Published by the Institution, Dawson-street.

Television for All. By Charles G. Philp. London: Percival Marshall and Co., Ltd., 66, Farringdon-street, E.C. 4. Price 1s.

Journal of the Worcester Polytechnic Institute, Worcester, Massachusetts. July, 1930. Worcester, Mass.: Published by the Institute.

Bulletin of the British Cast Iron Research Association, July, 1930. Birmingham: Offices of the Association, 24, St. Paul's-square.

The Theory of Heat Engines, including the Action of Muscles. By J. S. Haldane. Edinburgh: Oliver and Boyd, Tweeddale-court. Price 6s. net.

Regional and Town Planning in Principle and Practice. By W. H. McLean, Ph.D. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 21s. net.

New South Wales, Report of the Department of Public Works for the Year ended June 30th, 1929. Sydney, N.S.W.: Alfred James Kent, Government Printer. 1930. Price 3s.

Department of Overseas Trade. Economic Conditions in Roumania. Report by R. J. E. Humphreys. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

The Selenium Cell: Its Properties and Applications. By G. P. Barnard, with a foreword by John W. T. Walsh, M.A., D.Sc. London: Constable and Co., Ltd., 10–12, Orange-street, W.C. 2. Price 35s. net.

Guide to Sixth "Achema" Exhibition at Frankfort, with Addresses of Manufacturers of Chemical Plant and Machinery. Deutsche Gesellschaft für Chemisches Apparatewesen, Seelze, near Hanover, Germany. Price 1 mark.

Wastage in Imported Fruit: Its Nature, Extension and Prevention, being Special Food Investigation Report No. 38 of the Department of Scientific and Industrial Research. London: H.M. Stationery Office. 1930. Price 1s. 6d. net.

Department of Scientific and Industrial Research. Fuel Research, Technical Paper No. 26: The Influence of Size of Coal during Gas Manufacture. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 3d. net.

Trade Survey: An International Study of Trade Conditions. Prepared by the Economical and Statistical Department of B.E.A.M.A. London: The British Electrical and Allied Manufacturers' Association, 36, Kingsway, W.C. 2. Price 3s. 6d. net.

GERMAN ELECTRICAL STANDARDS AND RULES.—The following rules, which are edited by the Verband Deutscher Elektrotechniker (VDE), or German Association of Electrical Engineers, have now been printed in English:—No. 3001, Standards for the Classification and Testing of Electrical Machines R.E.M./1930 (Section VDE 452); No. 3002, Standards for the Classification and Testing of Transformers R.E.T./1930 (Section VDE 453); No. 3003, Rules for Insulated Conductors in Heavy Current Installations, Rules for Sheathed Conductors (Sections VDE 450/449); and No. 3004, Rules for Lead-covered Cables in Power Plants (Section VDE 403). Copies of these rules are to be obtained of the Central Office of the VDE, Berlin, W 57, Potsdamerstrasse 68.

Railway and Road Matters.

THE necessary powers to take over the small system, known as the Corris Railway, having been obtained in the recent session, the line is now part of the Great Western Railway.

AT a recent meeting, held at Doncaster, of railway shopmen to consider the dismissals on the London and North-Eastern Railway, the resolution passed included the remark that "Further, we are convinced that the time has arrived when a public inquiry shall take place regarding the administration of the railway services; until such has taken place we contend there will be no solution of this problem."

JUST before Parliament rose Mr. Morrison, the Minister of Transport, was asked whether any progress had been made with the scheme for the provision of a tube railway between Liverpool-street and Ilford. The Minister replied that he had been informed by the London and North-Eastern Railway Company that it is not yet in a position to make any further announcement with reference to that scheme.

ACCORDING to the railway accident returns for the three months ended December 31st last, the Assistant Inspecting Officers held 55 inquiries during the quarter into the more serious accidents to railway servants, of which 17 were fatal accidents, including 1 in which two men were killed. The causes assigned for the 17 fatal cases were:—Misadventure, 7; want of care, 6; no look-out man, 2; "failure to appreciate risk," 1; and failure of crane, 1.

IN presenting the Railway Returns for 1929 to the Minister of Transport, Mr. R. H. Hill, the Assistant Secretary of the Finance and Statistics Department, says that the total length of road open for traffic at the end of the year was 20,419 miles, an increase of 10 miles, and that of the sidings was 15,514 miles, an increase of 87 miles. Expressed as single track, the total length of running line was 37,169 miles, an increase of 26 miles. From a remark made by Mr. Hill it appears that one company now classifies 42 track miles of siding as running line. The corresponding figures for 1928 were adjusted accordingly, and the above particulars are therefore not affected.

WHEN Sir William Hoy retired in 1927 from the position of general manager to the South African Railways he found, being yet under sixty years of age, congenial but lighter responsibilities in the position of Chairman of the Railway Commission in Rhodesia. His death in February last left that office again vacant, and it has been filled by the appointment of Mr. Roger Gibb, of the goods department of the Great Western Railway. Mr. Gibb joined that railway in 1908, but resigned the following year to read for the Bar. He was called in 1913 and served in many useful offices during and after the war, and then returned to the Great Western. He is a son of the late Sir George Gibb.

A NOTED builder of bridges has been removed by the death at his home, Dundridge, Mannamead, Plymouth, on Thursday, August 21st, at the age of seventy-one years, of Mr. George R. Relf. He was the eldest son of the late Mr. R. T. Relf, of Plymouth, of the firm of Relf and Pethick, noted for its railway work in the West of England. In his day Mr. George Relf had a good deal to do with the big contract for the construction by a local company of the railway line from Devonport to Lydford, which was subsequently taken over by the then South-Western Company and used as its main line. He also built the Tavy and St. German viaducts for the Great Western Company, and replaced numerous other wooden railway bridges with stone viaducts.

THE annual report of the Indian Railway Board gives the value of the railway materials purchased. These were much less in 1928–29 than in 1927–28, owing to sundry unexceptional reasons that need not be explained beyond saying that they were not due to any question of policy. As the values are returned in crores of rupees, it may be advisable to say that a lakh is one hundred thousand rupees and a crore is one hundred lakhs. The total purchases in 1927–28 were 35·87 crores and in 1928–29 they were 29·63 crores; of the latter figure, 16·82 crores were for imported material and 12·81 crores for indigenous. Of the four principal engineering items, the figures were:—Rolling stock, 4·87 crores imported, 0·38 crores indigenous; tools and stores, 3·15 crores imported, 3·38 crores indigenous; permanent way, 2·53 crores imported, 4·47 crores indigenous; electric plant, 3·59 crores imported, 0·05 crores indigenous.

THE accounts that have appeared in the Press as to the £1,250,000 that is being spent on improvements at Bristol would convey the impression that the whole of that expense was being incurred by the Great Western Company. That, though, is not so as regards the passenger station, as that is jointly owned, in equal proportions, with the London, Midland and Scottish. Moreover, as the alterations in the station include the provision of six additional platforms, a spacious subway, connecting all platforms, for passengers, an independent subway for luggage, a new parcels office, and the improvement of the lines at the entrances from Bath and Exeter, it may be that a goodly proportion of the 1¼ million will be spent on the station, and therefore shared by the L.M.S. That company has its share in this valuable property as an inheritance from the former Midland Railway, and the history of the latter company's association with Bristol was related in THE ENGINEER of October 24th, 1924, in Article XVII. of our series "One Hundred Years of British Railways." An interesting point then recorded was that the Bristol and Gloucestershire Railway was the first section of what was to be the Midland Railway to be sanctioned, as it was authorised in 1828, and so two years before the Leicester and Swannington. Strange to relate, Brunel was the engineer and the line was of the broad gauge. When, however, the Midland acquired the road, it was changed to mixed gauge, and on May 29th, 1854, the first narrow-gauge train entered Bristol. What is now the main line portion of the station was then used by the Bristol and Exeter, and as it was an independent concern from the Great Western, a partnership of the three companies in the ownership of what is now Bristol Joint Station was made easy.

Notes and Memoranda.

ACCORDING to the *Chemical Trade Journal*, the present price of £8 per oz. for platinum is very near, if not actually below, the bare cost of production in the Transvaal.

A BUILDING of granite measuring 75ft. by 110ft., and weighing about 6000 tons, was recently moved bodily from one site to another 300ft. away in Pittsburg. The move also entailed a right-angle turn. Oxy-acetylene blow-pipes were used for cutting the granite where necessary.

THE Owyhee dam, which is being built near Nyssa, Oregon, for irrigation purposes, at an estimated cost of 6,000,000 dollars, is of the concrete arch type. It will be 405ft. high by 835ft. long and will impound 715,000 acre-feet of water. The watershed is 11,000 square miles, and the reservoir will irrigate 125,000 acres of land.

THE *Frankfurter Zeitung* attaches much importance to the recent discovery by a German chemist named Fehrenwald of an alloy of lithium and beryllium, the density of which varies from 1 to 1·5, according to the lithium content, which is present in the proportion of from 25 to 65 per cent. The alloy, which can be used in industry, is said to have none of the defects of pure lithium, to be hard, to oxidise slowly, while it is only slightly attacked by water. The cost of production is reported to be low.

DURING the past year the Dow Chemical Company, Midland, Michigan, has, says the *Chemical Trade Journal*, developed a new product known as orthophenylphenol for use as a glue preservative. The sodium salt, which has a phenol coefficient of 21, is water-soluble in all proportions, and is reported as being non-toxic to humans; 0·5 per cent. of sodium orthophenylphenate by dry weight has proved in all tests a complete control against both mould and putrefaction in glue. The material also improves the strength of the glue and has a slight bleaching effect. The cost of treating glue with this new material is said to be considerably less than with betanaphthol or thymol.

WHAT, it is believed, will be the largest fly-wheel motor generator set on record has been ordered by the Illinois Steel Company, Chicago, for use in its new 44in. reversing universal slabbing mill under construction at Gary, Ind., works. The set, which will be built by the Westinghouse Electric and Manufacturing Company, East Pittsburg, has a continuous rating of 10,500 kW—14,000 H.P.—and will carry peak loads of about 40,000 ampères. The set consists of three 3500 kW, 700-volt direct-current generators, coupled to a 6500 H.P., 25-cycle induction motor, with a 180,000 lb. fly-wheel, 15ft. diameter. The overall length is about 60ft. and the total weight of the set, including the fly-wheel, will be 600,000 lb.

ONE of the greatest annual increases ever recorded for a Canadian industry is that reported for the manufacture of radio sets and parts. A census of this industry points to an increase of 65 per cent. in the value of production for 1929 when compared with the immediately preceding year. The Dominion Bureau of Statistics reports that the production of complete radio sets, parts and batteries in Canada during 1929 reached a value of 20,966,137 dollars. That is a preliminary figure for the value of the industry and compares with 12,768,024 dollars reported for 1928. In addition to the above output, the furniture industry produced 87,200 radio cabinets worth 1,279,500 dollars in 1929, as compared with a value of 709,000 dollars in the previous year.

THE American Bureau of Standards has developed a visual signal-indicating device to guide mail aeroplanes over the Appalachian Mountains. An aural beacon system is at present in use. Coded signals are picked up by the head telephones, but this is found to put a great strain on the pilot, as he has to concentrate his thoughts when listening and must wear the telephones practically all the time. The new device consists of two vibrating white reeds. These will be placed on the instrument boards of the New York to Cleveland mail aeroplanes. The aviator can tell whether he is on the right path or not by watching the reeds. If the reed on the left vibrates most, he has turned off to the left of his course. Similarly, if the amplitude of the vibrations of the right-hand reed is greater, he will know that he has veered off to the right. When both vibrate alike the aeroplane is on the right course.

AT one time it was thought that combined harvester-threshing machines would be unsuitable for use in this country, since the grain is much more moist at harvest time than is the case in Canada or the United States, where the combined method is widely used. However, judging from last year's experience in the trials carried out by the Oxford Institute of Agricultural Engineering, it seems probable, says *Nature*, that, although in some seasons a drying plant might be necessary, threshing may be safely carried out after the grain has stood for a day or two in summer heat. This view is supported by experience abroad, and the combined machine is becoming increasingly used in countries with cooler and wetter climates. Given favourable conditions for hire or purchase, the farmer would gain considerably by its general introduction into Great Britain, as not only would the total cost of harvesting and threshing be reduced, but also loss from vermin or mould in the stack be avoided.

ACCORDING to a report on the Canadian asbestos mining industry issued by the Dominion Bureau of Statistics at Ottawa, a new high record in production was set up in 1929, deliveries amounting to 306,055 tons, valued at 13,172,581 dollars. These figures represent an increase of 12·1 per cent. in quantity and 17·2 per cent. in value, as compared with the 1928 production of 273,033 tons, worth 11,238,360 dollars. The average value of the 1929 production was also higher, operators receiving 43·04 dollars per ton as against the 1928 average of 41·16 dollars. Most of Canada's production of asbestos is exported. Including sand and waste, the export shipments in 1929 reached a grand total of 292,030 tons, made up of 5843 tons to Great Britain, 232,464 tons to the United States, 14,942 tons to Belgium, 13,996 tons to Germany, 10,698 tons to Japan, and smaller tonnages to Australia, British India, Cuba, Denmark, France, Italy, Mexico, Netherlands, Newfoundland, New Zealand, Spain, and Sweden.

Miscellanea.

IT is proposed to construct a reservoir for the supply of potable water to Nanking in the Tsinglisng mountains.

THE ninetieth annual Show of the Royal Agricultural Society of England will be held at Warwick from Tuesday, July 7th, to Saturday, July 11th, 1931.

IT is proposed to put up in Kutais, in the Transcaucasian part of Russia, a lithopone factory with a capacity of 12,000 tons a year. The expenditure on the plant is estimated at 2½ million roubles.

THE new bridge over the Vaal River at Christiana, on the Cape–Johannesburg route, was officially opened on August 20th. The bridge has five steel spans totalling 1000ft., and has taken two years to build.

THE China Institute of Scientific Management, which has for its aim the rationalisation of China's commerce and industries so as to increase the country's productivity, was formally inaugurated at the Shanghai Bankers' Club, on June 29th, Dr. H. H. Kung, Minister of Industry, Commerce and Labour, presiding over the meeting.

A NEW titanium lithopone, having the composition titanium dioxide 15 per cent., zinc sulphide 25 per cent., precipitated barium sulphate 60 per cent., is being offered to the rubber industry by E. I. du Pont de Nemours and Co. under the trade name "Ti-Tone." It is claimed that it has a covering power 60 per cent. greater than ordinary lithopone.

THE capacity of the Japanese wire rod works is about 160,000 metric tons, of which the Government Steel-works accounts for 60,000 metric tons, the Kobe Steel-works 50,000 metric tons, and the Asona-Kokura Works 50,000 metric tons. The latter are considering a way to improve their equipment to increase capacity to 180,000 metric tons, at a cost of about 1,000,000 yen.

IT is claimed that the two electrically driven air compressors recently ordered in Germany by the Victoria Falls Power Company, for service in the Transvaal, will be the largest of their kind ever made. Each will have a capacity of 43,000 cubic feet of free air per minute, raised from a pressure of 12·1 lb. to 117·1 lb. per square inch absolute. They will be driven by 9000 horse-power, 10,500-volt, three-phase, synchronous motors.

IT is reported that Professor Stoklasa, who was called in to give his opinion on the recent discovery of traces of radium at Ostrov (Schlackenwerth), in North-West Czechoslovakia, forecasts a big future for the springs and soil there. The quality of the soil, he says, is something quite new in the history of radium. Ostrov is about 5 miles south of Jachymov (Joachimstal), where Madame Curie first discovered radium, and about 8 miles from Carlsbad.

THE third International Congress of Mechanics opened at Stockholm on Monday last, August 25th, and will sit until to-morrow. The three different sections being dealt with by the Congress are Hydrodynamics and Aerodynamics, Theories of Elasticity and Solidity, and Problems of Oscillation. The universal character of the Congress is demonstrated by the fact that four official languages—French, English, German, and Italian—are being used.

THE Government has decided to send an aircraft carrier to Buenos Aires for the British Empire Trade Exhibition to be held there from March 14th to April 27th. A large and important exhibit of British aircraft will be included in the Exhibition, and the collection of British military and naval machines which will be taken in the aircraft carrier will no doubt stimulate interest in this section and improve the prospects of British constructors in the promising field of South America.

A REPORT on economic conditions in Persia by Mr. E. R. Lingeman, of the British Legation, Teheran, shows that so far there has been little in the way of electrical development in that country. The Government suggested some time ago that a foreign group should enter into partnership with it for the supply of water and electric power to Teheran, as well as the production of coal and cement for the town and railway, but the negotiations broke down. Hope for future business perhaps lies in the concluding paragraph of the report, which says that Persia is going through a transitional stage; she has left behind the old order and entered a new era of modernisation and reform.

AN International Shipping and Fishing Exhibition was opened at San Sebastian on Monday last, August 25th, and will continue open until September 10th. The Exhibition includes the display of fishing vessels and gear of all types, including internal combustion engines for marine service. There are sections devoted to systems of preserving and salting fish, ship decoration, and electrical apparatus such as wireless telegraphy and telephony, and there is also a section dealing with the construction of canals, harbours, and other public works. Demonstrations of marine apparatus and trials of new inventions will take place on the river Urumea, which flows past the buildings, during the continuance of the Exhibition.

ELEVEN ships now being built for the Anglo-Saxon Petroleum Company, Ltd., will be equipped by the Marconi International Marine Communication Company, Ltd., with the newest valve transmitting and receiving apparatus. The valve transmitters, known as the type M.C. 13, have a power of 1½ kilowatts and operate on interrupted continuous waves over the wave band 600 m. to 800 m., which is allocated to mobile stations by the Washington Convention. Interrupted continuous wave transmission is of great utility in extending the range and selectivity of a transmitter, and at the same time reducing interference with other stations. It therefore increases the value of the wireless installation to a ship because it can provide a more effective service. The receiver, type 352, installed with this type of transmitter, is a two-valve instrument, with the exceptionally wide wave range of from 15 m. to 20,000 m. As this instrument is entirely self-contained, it is an easy matter to change from one wave length to another and so to receive all the information required on a ship from the point of view of safety in navigation and of interest to the ship's *personnel*.

STEAM POWER STATION AT MALIM NAWAR, PERAK

(*For description see page 220.*)

FIG. 14—THE POWER HOUSE SITE, NOVEMBER 10TH, 1927

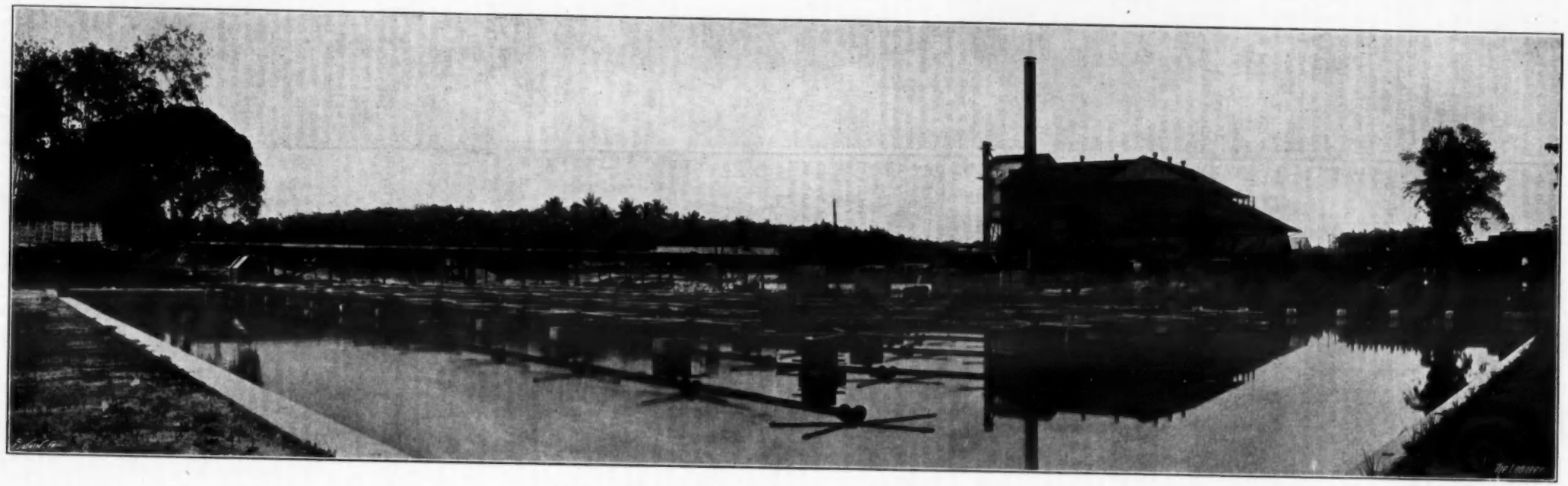


FIG. 15—SPRAY POND AND POWER HOUSE, OCTOBER 14TH, 1928

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The Metallurgist.

THE AUGUST NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE

THE ENGINEER.

VOL. CL No. 3894

AUGUST 29, 1930.

British Economic Mission to the Far East.

BRITISH industry is particularly interested in the despatch by the Government of an important Trade Mission to the Far East. The Chairman of this Mission is Sir Ernest Thompson, well known in Manchester, since he was formerly President of the Manchester Chamber of Commerce and is Chairman of the Executive Joint Committee of Cotton Trade Organisations and of the Cotton Trade Statistical Bureau. The engineering and iron and steel trades have a representative in Lieut.-Colonel Reginald Morcom, of Belliss and Morcom, Ltd., formerly Chairman of the Council of the British Electrical and Allied Manfuacturers' Association and now Vice-president of the Federation of British Industries.

At this time, when British exports as a whole are showing such a serious decline, it is of particular importance that every step should be taken to encourage overseas trade. The Far East is one of the few remaining markets which still afford immense possibilities for development. These possibilities are perhaps being realised more fully by our competitors than by British exporters. That the position of British trade with the Far East is not satisfactory, is shown by the fact that during the post-war period British exports to China have remained more or less stationary. On the other hand, the export trade to China of the United States, Japan, and Germany has been increasing very rapidly. The disturbances in China are, of course, detrimental to any form of trade, but this handicap is one which applies to our competitors as well as to ourselves, and, in spite of it, the import trade of China is making great advances every year, and our rivals are forging ahead. The United Kingdom is the only one of the great manufacturing countries whose trade with China has shown a serious decline since 1913; whereas in 1913 17 per cent. of China's imports were sent from the United Kingdom, only 9 per cent. were from that source in 1928. Contrasted with that decline, the United States of America increased their figures from 6 per cent. in 1913 to 17 per cent. in 1928; Germany increased hers from 3 per cent. in 1925 to 5 per cent. in 1928—the 1913 figure having been 5 per cent.—and Japan increased hers from 20 per cent. in 1913 to 26 per cent. in 1928. It is clear therefore that the main task of the Mission should be to ascertain the reason for this startling comparative and actual decline in British trade with China, and, if possible, to suggest what action could be taken by manufacturers and traders in this country to remedy the situation.

It is understood that the Mission is most anxious to obtain the views of trade associations and Chambers of Commerce interested in the Far Eastern trade as to the problems which it should examine. Those desirous of, or engaged in trading to China and Japan, are, therefore, invited to communicate to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1, their views as to the problems which the Mission should examine, and should also send any information which they consider to be particularly pertinent to the investigation. The Department will see that the information so gathered is communicated to the Mission. We would, therefore, suggest that those engaged in the engineering and iron and steel industries should take this matter into their serious consideration and communicate with the Department of Overseas Trade as soon as possible. The date on which the Mission leaves this country is understood to be September 19th next, so that there is no time to be lost.

The Rival Systems of Pulverised Coal Burning.

MACHINERY and mechanical processes may approach perfection by two quite different types of evolution. In the more usual case, they start from quite simple beginnings and grow more and more complicated by continual efforts to improve them. But complexity is, of itself, a defect and should processes be born with it, so to speak, as a result of the over-anxiety of their originators to anticipate all possible misdoings, the true course of evolution will be towards greater simplicity. That is apparently what is taking place as regards the development of pulverised coal firing for steam boilers. When the burning of coal in powdered form was first introduced into central station practice, there were many engineers who thought that the technical success was too dearly bought. If it was really necessary that the coal should be first dried by heating it in great revolving cylinders, then pulverised and afterwards separated from the air, stored and handled in the form of an impalpable and all-pervading dust, to be finally mixed with air and fed to the furnace, the expense and troublesome nature of the plant seemed likely to outweigh the advantages of the principle. These advantages, too, were clearly limited. The margin between even perfect combustion and that obtainable by ordinary mechanical firing was small, while stoker designers had not said their last word, either as regards efficiency or practicable size. The new system, however, made headway, its advocates being powerful, and their propaganda good. But having demonstrated that powdered coal could be burnt effectively under boilers without insuperable furnace difficulties, their insistence on the merits of their process had the natural effect of raising the question as to whether equally good results could not be achieved by very much simpler means. As a consequence, the system of direct firing came into being, the coal in its raw state being pulverised and delivered straight from the mill to the furnace in accordance with the demand for steam. The mill, indeed, merely replaced the mechanical stoker, the system of direct firing thus eliminating at one stroke a vast amount of cumbersome apparatus previously claimed to be essential to the use of pulverised coal. It was not to be expected that development along such lines would meet with the approval of those whose reputations and interests were bound up with the success of the much more elaborate plant. Hence arose a controversy as to the merits of the rival systems, which, like most general arguments, probably tended rather to confirm beliefs and prejudices than to convert opponents. Time, however, can usually be depended on to produce facts more convincing than any reasoning, and the very definite trend of practice towards direct firing is a fact which is unanswerable. Although the central, or "bin," system had a good start in the United States, where pulverised coal burning had the earliest and the greatest development, more than three-

quarters of the boiler heating surface equipped for powdered fuel last year was fired by the direct system. For ordinary industrial steam plants, the bin system has been thoroughly outdistanced by its simpler rival, so that what controversy is still possible, centres round the respective advantages of the two systems for large power stations, in which the bin system still preponderates.

A useful contribution to the discussion has recently been made by Mr. A. E. Grunert, of the Commonwealth Edison Company, who has presented a paper to the A.S.M.E. embodying the results of lengthy comparative tests of the rival systems. A cross drum boiler of the marine type, having a heating surface of 5940 square feet, exclusive of another 2468 square feet of heating surface in the furnace walls, was the subject of the experiment. The unit was put into service in 1926 with all the usual auxiliary apparatus for burning pulverised coal on the bin system. It was, indeed, a typical example of such an installation, representing the highest development of the art at the time. Load conditions rendered it advisable that the boiler should be operated for sixteen hours per day, being shut down at nights and on Sundays. The day load was practically steady at about 140,000 lb. of steam per hour, except for an increase at the time of the evening peak and a drop at noontime. When the boiler was shut down the dampers were closed, and the pressure allowed to drop. It could be brought back to its normal duty in about fifteen minutes after a night's stoppage, and in from fifty to sixty minutes after its week-end rest. For two years it ran under those conditions. Its performance was closely supervised and the metering devices frequently checked to ensure substantial accuracy of the records. In 1928 the equipment was converted to the direct system of firing, and, in the words of Mr. Grunert, "the many and varied experiences of two years of operation with a bin and feeder system were such that no particular pangs of regret were evidenced by those concerned when the change took place." The conversion, however, did not eliminate all objectionable conditions, "because the unit system in its later operation also developed a few inherent mulish traits." Much as one would like to know Mr. Grunert's own opinion, as to the benefit or otherwise of the change, his paper hardly indicates it except in so far as it may be deduced from the phrases quoted. He gives, however, a wealth of figures, both technical and commercial, relating to lengthy operating periods with the two systems, as well as over fifty test results. The most useful comparison can probably be made between a seven months' operating performance of the bin system and an eleven months' performance with the direct system, Central Illinois coal being used throughout both runs. This is a comparatively low grade coal, the average analysis during the trials of the bin system showing 12·9 per cent. moisture, 12·13 per cent. ash, and a calorific value of 10,626 B.Th.U. per lb. During the direct firing trials the moisture and ash were both somewhat higher and the calorific value down to 10,314 B.Th.U. Under such conditions, the bin system resulted in an average boiler efficiency of 83·74 per cent., with an auxiliary power consumption of 50·72 kWh per ton of coal fired, as against an efficiency of 83·70 and a power consumption of 51·31 kWh per ton in the case of the direct fired system. The figures, as will be seen, are remarkably close, and may be taken for practical purposes as the same, in view of the variation in the quality of the fuel in the two cases. There was therefore little or nothing to choose between the systems, so far as efficiency is concerned. The same tale is told by the tests, and Mr. Grunert remarks that in respect of efficiency, "there really is not much difference between these methods of firing." There seems—he adds—"to be a tendency to detract from the unit system for reasons based mostly on theoretical considerations, but in actual performance these differences do not seem to be very noticeable."

If we turn to the operating costs we find the same practical equality. With the boiler running for seven months on the bin system with Central Illinois coal, the fuel cost per 1000 lb. of steam delivered amounted to 0·25618 dollar, and the total costs, including operating labour, maintenance charges, auxiliary power, and fuel, amounted to 0·30324 dollar. During the eleven months' operation on the direct firing system, with the same fuel, the corresponding figures were 0·24633 and 0·30254 dollar. In the face of such an extraordinary similarity in total costs, neither system can be said to be preferable to the other as regards cheapness of operation. It is, however, a pity that maintenance costs could not be given for much longer periods, so as to provide a fairer average for the repairs which only occur occasionally. It may be, indeed, somewhat fortuitous that the totals given are so close, for if we consider individual items, it is difficult to see why, in the direct fired period, for example, furnace maintenance per 1000 lb. of steam should be 27 per cent., boiler and superheater maintenance 15 per cent., and soot-blower maintenance 85 per cent. cheaper than when the boiler was fired on the bin system. On the other hand, the total maintenance costs of the coal and ash equipment, per 1000 lb. of steam, were apparently more than double under the direct firing system, the figures being 0·00924 and 0·01961 dollar respectively. The more one studies the items of running cost, the less ground there seems for asserting that either system is demonstratably cheaper to operate than the other. But what we might have been told, and it would have dispensed with the necessity for interpretation which always attaches to operating costs, is the absolute or even the relative capital costs of the two installations. Economies are often problematical, maintenance costs are erratic, but the fixed charges due to capital investment are as certain as death. If one system of coal burning can be installed more cheaply than another, it has an initial commercial advantage, which can only be counterbalanced by a definite saving in fuel, maintenance or labour. The question of capital cost has been purposely left out of consideration by Mr. Grunert. He has, however, been delightfully frank as regards operating difficulties, both great and small. It is permissible to believe that if one thing more than any other brought about the decision to replace the bin system by direct firing it, was the intolerable nuisance of coal dust experienced with the former. It was a nuisance, not only in the plant itself, but to the neighbourhood as well. By pulverising the coal only as it is passing to the furnace, the messiness and dirt due to the escape of dust are almost or entirely eliminated. Another nuisance affecting the public is caused by the fly ash and sulphur fumes ejected with the flue gases. A water spray apparatus between the air heater and induced draught fan was installed to wash the gases. It appeared to eliminate more than 90 per cent. of the solid matter carried in the flue gases, but no appreciable reduction of the sulphur contents could be found. That seems all the more curious because we are told that corrosion due to sulphur acids was so serious that all the duct work between sprays and fan suction had to be cement lined, and the drain piping had to be lined with rubber. Where could all the sulphur have come from, if not out of the gases? The ash and sulphur questions, however, are common to both systems of pulverised fuel burning, and to a less extent they have to be faced when fuel is burnt in the solid state. The reference to them by Mr. Grunert does, nevertheless, indicate that his paper is by no means confined to the comparison which is the groundwork of it. Still less does he try to make a case for either system. The advocates of each will find much to like and much to dislike, but we think that station engineers without exception will regard it as one of the most practical and interesting accounts of pulverised coal burning that has yet appeared.

Report on London Waters.

No. II. (*Conclusion*).*

In our first article we dealt with the first portion of Sir Alexander C. Houston's Twenty-fourth Annual Report on the results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended December 31st, 1929. We now turn to the second portion, which deals with the service reservoirs of Water London. Sir Alexander has given to this portion of his Report the euphonious—as he styles it—title of "The Sentinels of London Water."

The Sentinels of London Water.

The comparison suggested by this title is certainly apt. The word "Sentinel," remarks Sir Alexander, "seems to fit in so well with that equally wonderful word 'Service.' Sentinels are outposts guarding the troops more centrally situated. They occupy a position of great responsibility and they are everlastingly vigilant. So it is with the service reservoirs, they maintain a constant supply of water to London, almost irrespective of questions of elevation and of maximum consumption. They cover periods of emergency, as when great mains burst, or disastrous fires occur. They balance, or equalise, consumption, thus tending in the direction of allowing the use of less powerful engines, less continuous pumping, and the use of smaller mains than would otherwise be the case. They are the handmaidens of thrift and convenience, for any curtailment of their size or number would mean uneconomic expenditure elsewhere and inconvenience to the public."

Filtered and purified water is raised by the pumping engines into these reservoirs which are "usually situated at a high level, either actually or in relation to the area supplied with water. Betsom's Hill reservoir in Kent is no less than 818ft. above sea level." At times the demand for water is greater than the volume being pumped through the main into the service reservoir, which thereupon makes up the deficiency and the water level in it falls. At other times, for instance, during the night, the converse holds good; the amount being pumped exceeds the amount drawn off from the reservoir, the water level in which rises higher and higher, "and so a state of equilibrium is maintained." How great the variation of flow may be during the twenty-four hours, Sir Alexander illustrates by means of a curve, which we reproduce, and which is a graphic record showing the flow of water during a period of twenty-four hours to a residential district in the Outer Suburban Area. During the small hours of the night, he explains, the flow may be six times less than during the maximum periods of consumption.

Service reservoirs are covered over, but not "sealed" in any way, being, on the contrary, kept well ventilated. The covering naturally tends to keep the water warmer during the winter and cooler during the summer, but the main reasons for its use are to keep out surface impurities and to prevent the development of harmless, but undesirable, growths in the water by depriving them of light.

These service reservoirs—"Sentinels, balancing tanks, call them what you will"—are, says Sir Alexander, "a great boon to London, to those particularly who live in high places, to manufacturers, to those whose duty it is to fight fires in the protection of property, and in the interests of public health." They extend, north, east, south, and west—to Haileybury, Southfleet, Westerham, and Hanworth respectively. There are 93 of them, and they hold, collectively, 322 million gallons, or enough, at 35 gallons per head per day, to give ten days' supply to Birmingham or "a year's supply to the famous Cathedral City of St. Albans."

Our readers will remember that originally eight water companies supplied the needs of London. They were the Chelsea, the East London, the Grand Junction, the Kent, the Lambeth, the New River, the Southwark and Vauxhall, and the West Middlesex. The Water Examination Department of the Board, of which Sir Alexander Houston is Director, still retains that classification, but for administration purposes the area served by the Board is split up into the following:—

I. Kent District.
II. Northern District (formerly East London and New River).
III. Southern District (formerly Lambeth and Southwark and Vauxhall).
IV. Western District (formerly Chelsea, Grand Junction and West Middlesex.)
V. Stations under Central Control.

The Western District.

Following the same practice as in preceding Reports, Sir Alexander takes his readers on imaginary tours through each of these Districts in turn, illustrating these tours by diagrammatic maps and photographs. He starts with the Western District, because, for one reason, as he explains, most of the service reservoirs contained in it lie within easy reach of the Water Examination Laboratories, and are best known to him. The Western District extends from Sunbury-on-Thames in the west, to Charing Cross in the east, and from the River at Charing Cross to Hendon in the North. Its area is no less than 76½ square miles, and the population numbers over 1,722,000.

The first Service Reservoirs met with on the journey are those on Campden Hill. They are, of course, covered—in fact, a portion of the roof surface is let to a lawn tennis club—they are 21ft. deep and they hold, when full, 15,750,000 gallons. They stand at an elevation of 134·5ft. above Ordnance Datum, and they receive water from the Kew Bridge and Hammersmith pumping stations. There was formerly another reservoir—belonging to the West Middlesex Company—at this place, but it was abandoned a number of years ago, and is now used as a garage by a motor company, after, by the way, having served for some time as a range for a miniature rifle club.

Water from these works is pumped over a standpipe 270ft. above O.D., and supplies the area forming the Shoot-up Hill zone, which is in the northern part of the District.

The next reservoirs visited are those on Putney Heath. There are five of them, with depths varying from 12ft. to 21ft., and they hold altogether 22,000,000 gallons, which, as Sir Alexander comments, is sufficient to give as large a city as Sheffield appreciably more than a day's supply. Their elevations vary from 171·62ft. to 177·87ft. above O.D. They are supplied with filtered water from the Surbiton (Chelsea), and are covered and sodded.

The tour then takes the visitor to the Kew Bridge Works (Grand Junction). There, there are, strictly

* No. I. appeared August 22nd.

speaking, no service reservoirs, but there are two covered reservoirs, with a capacity of 2½ million gallons, for filtered water and a standpipe tower with a top water level of 190·5 above O.D. These covered reservoirs form a sort of reserve for filtered water which is pumped to the Town and Ealing zones. They lie under two of the filter beds at these works.

The tourists then proceed to Ealing, where there are two uncovered filtered water reservoirs. One of them, "called a service reservoir," holds 3 million gallons, has a depth of 12ft., and a top water level of 205ft. above O.D. It receives water from the Kew Bridge Pumping Station. There is also a standpipe tower and a tank, holding 15,800 gallons, at an elevation of 265ft. above O.D. The other reservoir is called a storage reservoir, "apparently in the sense that it is kept full, or partially full, from the higher, but much smaller reservoir, and the water stored in it is used only to a slight extent for supply purposes." It is known as the Fox Reservoir, is 38ft. deep, has the very large capacity of 50,000,000 gallons, and its top water level is 193·5ft. above O.D.

"It will be asked," says the Report, "why these reservoirs were not covered over originally. The answer probably is that when they were constructed many years ago the *rôle* played by light in encouraging the development of harmless vegetable growths was not fully recognised. It would cost a very large sum of money to remedy matters now, and no doubt there would be considerable engineering difficulties attached to such an undertaking."

Four more service reservoirs were visited in this tour. They were the Willesden, Shoot-up Hill, Kidderpore, and Barrow Hill. The Willesden reservoir is 16ft. deep, holds 2½ million gallons, and has a top water level of 190ft. above O.D. It receives filtered water from Hammersmith. The Shoot-up Hill reservoir is 20ft. deep, contains 6 million gallons, and has a top water level as high as 258ft. above O.D. It is fed with water pumped direct from Hammersmith, and also from the pumps connected with the Willesden, Campden Hill, or Cricklewood (Northern District) service reservoirs.

The Kidderpore reservoir lies higher than even that at Shoot-up Hill. Its elevation is 323ft. above O.D. It contains 2½ million gallons, is 16ft. deep, and it is fed from Barrow Hill or Cricklewood. The Barrow Hill reservoir, which is supplied by pumping from Hammersmith, is 19·5ft. deep and holds 4¾ million gallons.

THE NORTHERN DISTRICT.

A fair proportion of the filtered water going into the Northern District comes from the Thames (Kempton Park Pumping Station), and the amount will be augmented considerably in the future. The bulk of the supply to the covered service reservoirs, however, was, at the date the Report was written, derived from the Lee and the New River.

The tour through the Northern District is divided into two stages. The first service reservoir visited in the first stage was that at Claremont-square. It holds 3½ million gallons, is 19ft. deep, and has a top water level of 139ft. above O.D., while there is a standpipe rising to 185ft. above O.D. It is supplied with water from the New River Head Pumping Station, and occasionally by gravitation from the Maiden-lane and Crouch Hill service reservoirs. At Maiden-lane there are two service reservoirs, holding, together, 15 million gallons, "or enough water at 35 gallons per head per day to supply a town the size of Plymouth for two days." The depth is 22ft. and the top water level 232ft. above O.D. Water is received from Stoke Newington and Cricklewood.

The Hornsey-lane reservoir, the next on the route followed, has a top water level of 348·2ft. above O.D. It has a capacity of 3 million gallons, and a depth of 11·5ft. It is supplied with water from the Hornsey Station. At Crouch Hill there are two reservoirs with a combined capacity of 12 million gallons. The Fortis Green reservoir, the next to be visited, is another fairly big one, holding as it does 10 million gallons, or enough to supply Bradford for one day. It also stands high, its top water level being at 298ft. above O.D.

Several very high reservoirs are then visited. First there is that at Highgate, where the top water level is no less than 427·35ft. above O.D., while a standpipe reaches 478ft. above O.D. It is, however, comparatively small, as it only holds one million gallons. The two reservoirs at Hampstead Heath, which together contain 1½ million gallons, are higher still—in fact, they are the highest reservoirs north of the River Thames—the top water level being 446·2ft., while the standpipes reach a level of 487·3ft. above O.D. All these three reservoirs receive water from the Hornsey-lane and Fortis Green pumping stations. At Cricklewood there are two service reservoirs, holding two million gallons, which are used for balancing the deliveries of water from the Kempton Park and Cricklewood pumps. They are much lower then those referred to above, the top water level being only at 140ft. above O.D.

In the second stage into which the tour through the northern district is divided the service reservoirs at Finsbury Park, Bourne Hill, Southgate, Holtwhite's Hill and Bycullah, Darnicle Hill, Haileybury, High Beech, Buckhurst Hill, Woodford (or Haggar-lane) and Ferry-lane are visited. With regard to the latter, it may be said at once that it is not a service reservoir in the true sense of the term. Its top water level is only 20ft. above O.D., and it holds 165,429 gallons of water, which is sent either to the Stoke Newington Works or to the Finsbury Park, Crouch Hill, or Woodford reservoirs, as may be desired.

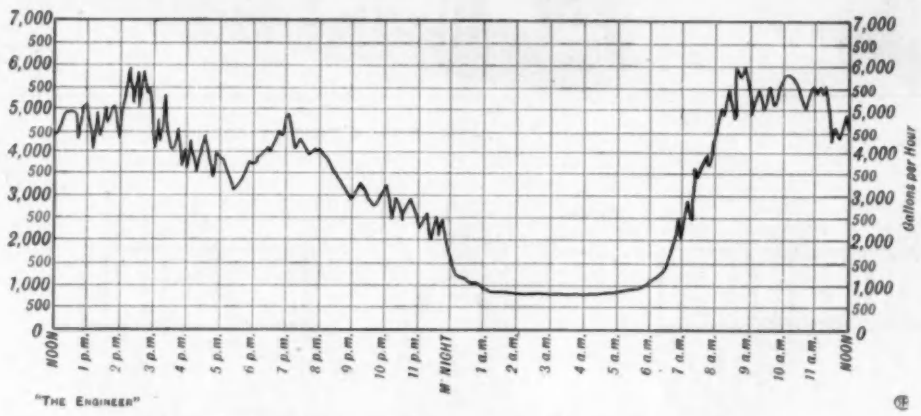


CHART SHOWING HOURLY VARIATION OF CONSUMPTION OF WATER

The leading particulars of the other reservoirs in the area traversed are set out in Table I.:—

TABLE I.—*Service Reservoirs in the Northern District.*

Reservoir.	Depth, feet.	Capacity.	Top water level, feet above O.D.
Finsbury Park ..	11·5	5·0 mil. gals.	142·0
Bourne Hill	12·0	1·5 ,,	195·5
Southgate	11·5	1·0 ,,	308·0*
Holtwhite's Hill and Byeullah (2) ..	—	1·774 ,,	224·92†
Darnicle Hill	18·0	1·0 ,,	367·0‡
Haileybury	—	96,000 gals.	359·0§
High Beech	14·0	2·5 mil. gals.	371·0‡
Buckhurst Hill ..	18·5	800,000 gals.	270·0
Woodford—			
(2) Low level ..	14·0	10·0 mil. gals.	167·5
(1) High level ..	25·0		182·0

* Standpipe 333ft. above O.D.
† Tank on top of tower 291·81ft. above O.D. These reservoirs are fed with well water and not filtered river water.
‡ Supplied with well water.
§ Covered steel tank, supplied with well water.

The Botany Bay Water Tower is also included in this tour. It is a circular steel Tank, 20ft. in diameter, and 15ft. deep. It has a capacity of 30,000 gallons, and its top water level is at 424ft. above O.D. It is fed with well water from Hadley-road Well.

SOUTHERN DISTRICT.

The tour of inspection in the Southern District passes through Battersea, Brixton, Streatham Hill, Norwood, Selhurst, Crystal Palace, Rock Hill, Forest Hill, Honor Oak, and Nunhead. At Battersea, where there used to be a number of filter beds and a pumping station, there is now only a balancing reservoir, and as the land has been sold to the London Power Company, the question of future intercommunication works is under consideration.

The most important service reservoir on the route is that at Honor Oak. It extends over no less than 14¼ acres, has a depth of 34ft., a top water level of 144ft. above O.D., and it contains no less than 56,322,370 gallons. It is said, indeed, to be the largest reservoir of its kind in the world. It is supplied with water from Walton and Honor Oak Well, and has outlet pipes for the supply of the Southern and Kent Districts. Water can also be pumped from it to Nunhead reservoir.

Another interesting service reservoir is the tank at the Crystal Palace. Of it, Sir Alexander quaintly remarks: "The tank . . . is as great a blot on the landscape as the landscape is beautiful when viewed from its summit." It stands 81ft. above ground level and its top water level is no less than 438ft. above O.D. It measures 48ft. square by 13ft. 3in. deep, and it holds 191,000 gallons, the water coming from Brixton.

The particulars of the remainder of the Reservoirs in this District are set out in Table II.:—

TABLE II.—*Service Reservoirs in the Southern District.*

Reservoir.	Depth, feet.	Capacity.	Top water level, feet above O.D.
Brixton (2)	15·25	10·32 mil. gals.	115
Streatham Hill (2) ..	12·25 14·5	8·50 ,,	197*
Norwood	15·5	4·75 ,,	218
Selhurst	16·0	2·50 ,,	216
Rock Hill	16·0	0·50 ,,	356
Forest Hill (2) ..	—	1·00 ,,	340
Nunhead (2)	20·0	12·50 ,,	168†
,, (2)	14·0	6·00 ,,	196†

* Receive a little water from Streatham Common Well in addition to water from other sources.
† These reservoirs are supplied with water from Honor Oak, and also from Hampton and from Streatham Common Well.

THE KENT DISTRICT.

The service Reservoirs in the Kent District are many and various as well as being widely separated. They extend from New Cross on the West to Southfleet on the East, with Westerham Town on the extreme south. In view of the wide area to be covered, Sir Alexander finds it necessary to divide the tour into two stages. The first is made from West to East, and proceeds by way of Deptford, Greenwich Park, Eltham, Shooters Hill, Woolwich Common, Plumstead, Dartford, and Southfleet. The second stage embraces New Cross, West Wickham, Betsom's Hill, Westerham Hill, and Westerham Town, the return journey being made *viâ* Knockholt, Chelsfield, Farnborough, Chislehurst, Bickley and Bromley.

As it would be impossible to speak in detail of all the service reservoirs visited, we have embodied their leading particulars in Table III.:—

TABLE III.—*Service Reservoirs in the Kent District.*

Reservoir.	Depth, feet.	Capacity.	Top water level, feet above O.D.
First stage:			
Deptford (2)	8 to 8·5	1·750 mil. gals.	15·25
Greenwich Park ..	—	1·125 ,,	158·00
Eltham (2)	16	5·695 ,,	240·25*
Shooters Hill	11	0·835 ,,	333·50
Woolwich Common ..	12	1·500 ,,	248·00
Shooters Hill	75	0·202 ,,	489·13†
Plumstead Common	10	0·650 ,,	170·00
Plumstead (3) ..	10	0·600 ,,	90·00
Dartford Brent ..	16	0·370 ,,	139·80
Southfleet	16	1·000 ,,	316·00
Second stage:			
New Cross	14	1·750 ,,	163·00
West Wickham ..	10	0·250 ,,	550·00
Betsom's Hill (2) ..	8 8	0·068 ,, 0·245 ,,	818·00
Westerham Hill ..	12	0·315 ,,	585·00
Westerham Town ..	15	0·060 ,,	444·00
Knockholt Beeches	10	0·500 ,,	795·00
Chelsfield	12	0·763 ,,	570·00
Farnborough (2) ..	15	1·400 ,, 1·525 ,,	439·00
Chislehurst	11	0·450 ,,	315·00
Bickley§	10	1·500 ,,	307·00
Bickley‡	10	1·500 ,,	307·00
Bromley	16	5·000 ,,	250·50

* Water is received from no less than six pumping stations:—Darenth, Wilmington, Overy-street, Crayford, Wansunt, and Shortlands.
† Water Tower; also a standpipe for emergency use.
§ Circular.
‡ Rectangular.

The large majority of these reservoirs are fed with well water. The Report says concerning them that although "they do not hold individually the amount of water pertaining to some of the other districts, they are for the most part situated at commanding levels. . . . Only six of them are situated at a lower elevation than 200ft., and eight of them range from 439ft. up to a maximum of 818ft. above Ordnance Datum."

The foregoing gives in brief outline the leading technical particulars of the "Sentinels of London," as set out in the Report. It would be extremely difficult to give any adequate idea of the charming manner in which the subject is treated. There is hardly a reservoir about the neighbourhood of which Sir Alexander has not something interesting to say. Sometimes, it may be, attention is drawn to a particularly beautiful view; sometimes, references are made to events which have taken place in the past in the vicinity; or, perhaps, we are told of eminent personages of by-gone days who lived nearby. In all he has written there are evidences of depth of reading and catholicity of outlook which seem to cover with a cloak of interest the dry bones of the statistics. We should much like to quote some of the delicate pen-pictures with which this part of the Report is plentifully besprinkled—but they are not "engineering," and we must forebear. A word must, however, be said of the reproductions of photographs with which the volume is illustrated. Many of them were, evidently, taken by Sir Alexander himself. First, there are five aerial photographs of London, which, it is explained, "give an excellent idea of the kind of view you may obtain on a *clear* day from the more exalted service reservoirs of the Board." Then there is a series of sixty views showing places visited or passed through during the various tours. Many of these views are artistic gems. We feel sure that those who are fortunate enough to gain possession of one of these Reports will be pleasingly entertained in reading it.

2140 B.H.P. DOUBLE-ACTING TWO-STROKE MARINE OIL ENGINE

EARLE'S SHIPBUILDING AND ENGINEERING COMPANY, LTD., HULL, ENGINEERS

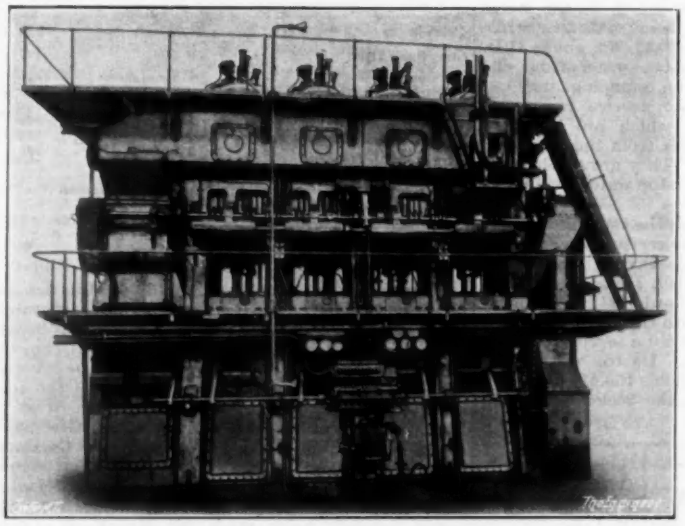


FIG. 1—FRONT VIEW OF ENGINE

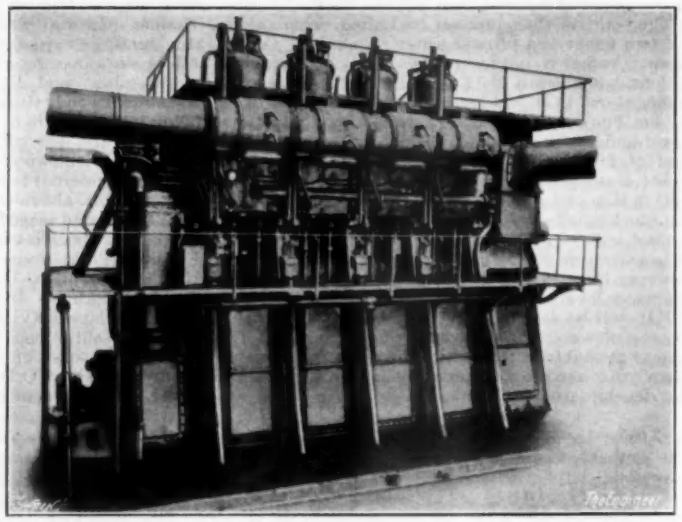


FIG. 2—BACK VIEW OF ENGINE

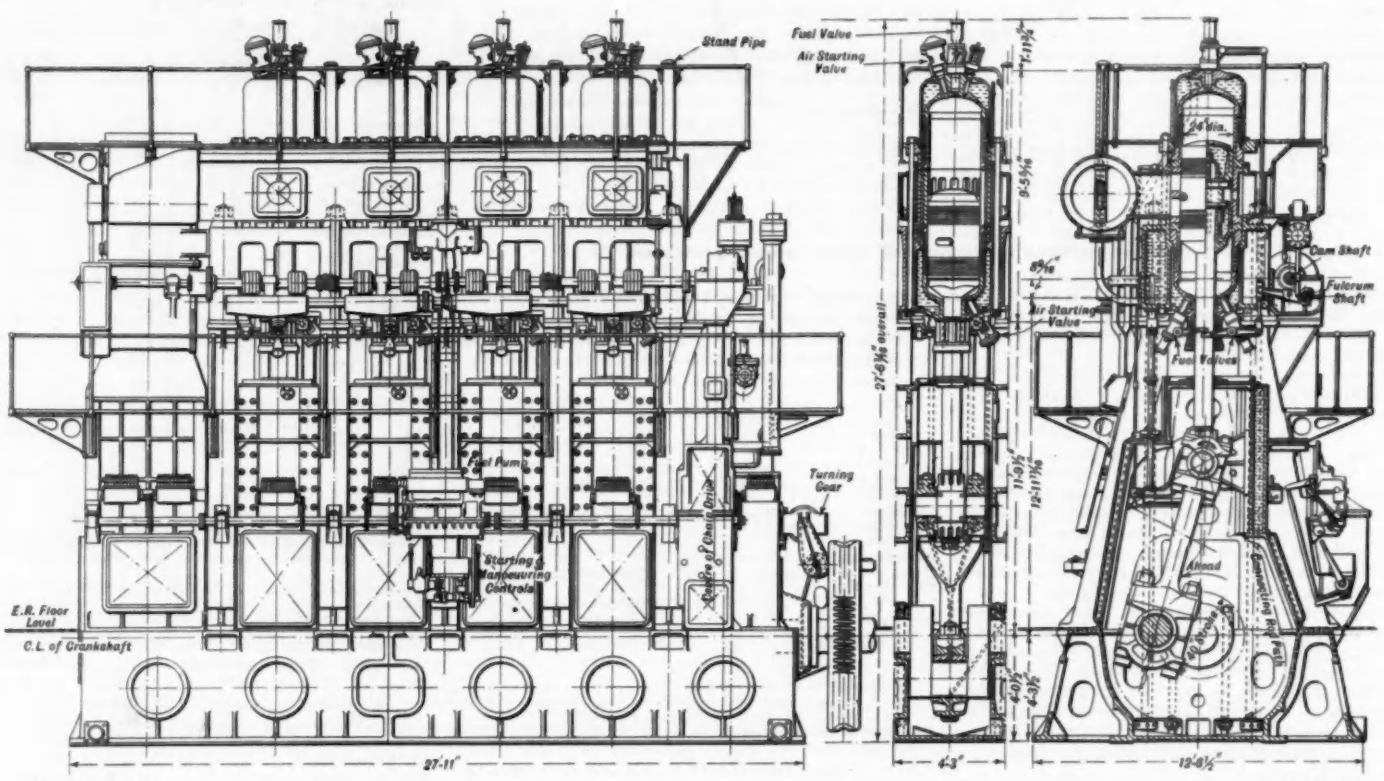


FIG. 3—ELEVATION AND TWO SECTIONAL VIEWS

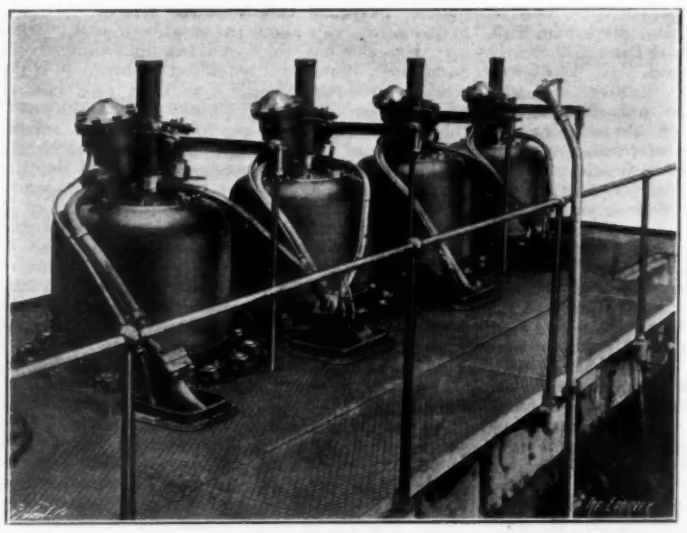


FIG. 4—VIEW ON THE TOP PLATFORM

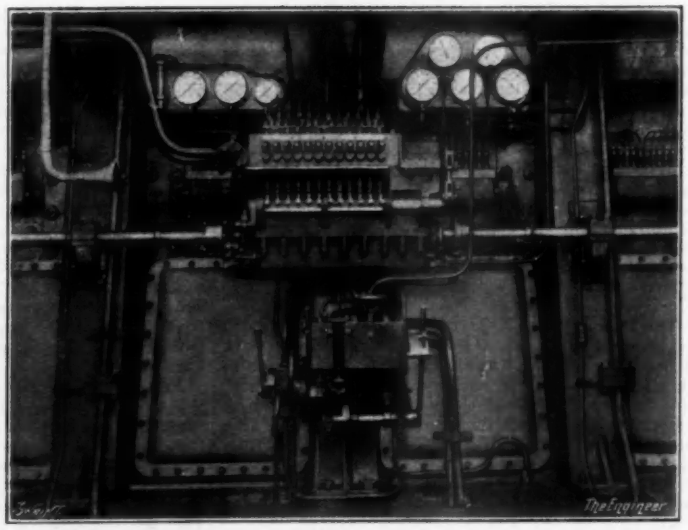


FIG. 5—FUEL PUMPS AND CONTROL STATION

2140 B.H.P. Double-acting Two-stroke Marine Oil Engine.

Progress in recent marine oil engine design has tended in the direction of the increasing adoption of the two-stroke double-acting principle, with simplification in constructional details, so as to enable engines to be produced at lower cost, without, however, sacrificing the essential factor of reliability under actual sea-going conditions. A further step in this direction has recently been taken by Earle's Shipbuilding and Engineering Company, Ltd., of Hull, which firm has constructed under a non-exclusive licence agreement with Mr. J. O. Jorgensen, an improved type of double-acting, two-stroke, marine oil engine, employing a conservative indicated mean effective pressure rating, low-pressure scavenging, with salt water cooling for the principal parts. In a paper read before the Hull Association of Engineers on Friday, August 8th, Mr. Jorgensen discussed the work of the designer in relation to sales and production, and emphasised some of the more novel features in the design, which, by simplifying the castings and parts to be machined, has made possible economical production in the works. He also gave his reasons for adhering to air injection and for the adoption of the moderate indicated mean effective pressure of 85 lb. per square inch, with its corresponding good overload capacity, and described the engine generally. It is of interest to recall that Mr. Jorgensen has been closely identified with the development of the marine oil engine from its earliest days. He was with Burmeister and Wain, Ltd., of Copenhagen, at the time the motor ship "Selandia" was designed and built, and he was, later, in charge of the Glasgow factory of Burmeister and Wain, Ltd., when the motor vessel "Mississippi" was built and engined. From 1919 to 1927 Mr. Jorgensen was associated in a consulting capacity with the Worthington Pump and Machinery Corporation of New York, in the construction of the double-acting, two-stroke engine for the motor ship "Tampa," which engine was described and illustrated in our issue of October 3rd, 1924. In what follows we deal with the principal features and test performance of the new Earle's-Jorgensen engine, the general appearance and arrangement of the engine being illustrated on page 232 opposite.

Main Constructional Details.

The engine has a designed full load output of 2140 B.H.P. at 98 r.p.m., there being four working cylinders, each having a bore of 24in., with a stroke of 40in. As shown in Fig. 3, the scavenge pump is placed at the forward end of the engine, with the three-stage air compressor at the after end, both of these units being directly driven from the main crank shaft. By setting the main cranks, so that the eight firing impulses of the top and bottom cylinders occur at equi-distant points around the crank circle, it is being found possible by taking into account the compressor and scavenge pump reciprocating masses, so to arrange

Fig. 6—Engine Framing

the masses and inertia forces that a very smooth running engine with completely balance forces of the first and second orders, and couples of the first order, is obtained without having recourse to balance weights on the cranks. As our drawing shows, a deep bed-plate with a flat bottom which can be directly bolted to the tank top, without a built-up seating, has been chosen. The bed-plate casting, which is made in halves, is very robust, and, in addition to the longitudinal girders, there are transverse members of box section which take the main bearings. Provision is made for four sets of chocks, and the inner sets are reached through large openings provided in the sides of the bed-plate. A simple crank shaft of the semi-built-up type is used, which at its after end is furnished with a coupling to which the turning wheel, with its electrically driven gearing, is attached.

The engraving, Fig. 6, shows the five "A" frames, which enclose the running gear, and to support the entablature which serves as a base for the cylinders. As the right-hand sectional view in Fig. 3 indicates, the columns and the entablature are secured to each other, and are held down to the bed-plate by through-going tie bolts passing to the underside of the bed-plate. In the foreground of Fig. 6 the framing for the scavenge pump may be noted, details of this pump being shown in Fig. 10. Between the columns there are placed the crosshead guide plates, which are water-cooled and the crank case is completely enclosed by further cast iron plates and large doors of cast aluminium. The doors are so designed that they are very light

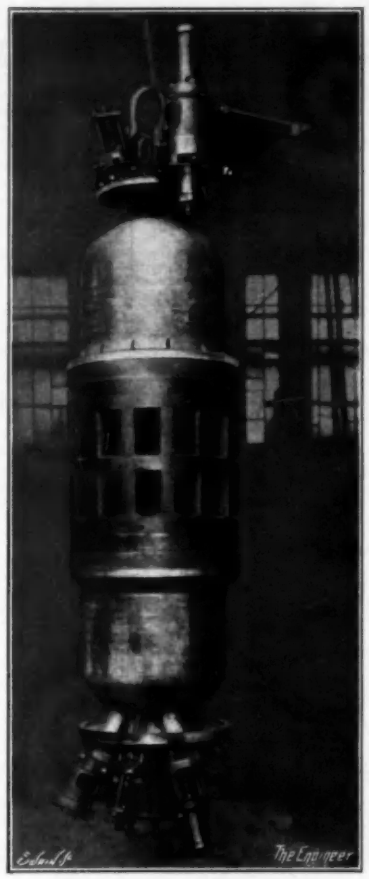


Fig. 7—A Complete Cylinder Unit

to handle, and so can be quickly removed for purpose of the inspection of the bearings and the reciprocating parts. A simple design of crosshead is employed and the piston-rod is, it will be seen, secured by two nuts, one above and one below the crosshead pin, which can be unscrewed when withdrawing the piston-rod.

One of the most interesting features of the engine is the use of forged steel shells of spherical shape for the combustion spaces. The shells are attached to the centre portion of the liner which contains the exhaust and the scavenge ports. Cooling water passages are made through the bars between the ports, so as to allow of a free flow of cooling water throughout the liner spaces. As shown by the sectional drawings the steel shells are furnished with cast iron liners which extend far enough to cover the whole of the surface swept by the piston rings. Each cylinder is, as Fig. 7 illustrates, self-contained, and the fuel, starting air, and relief valves are bolted direct to large steel flanges, which are forged in one piece with the top and bottom steel shells. There are water-tight passages connecting the valves with the combustion spaces. The complete cylinder unit is supported in the entablature casting and rests on its lower shoulder, being secured by a clamping ring which engages with the top shoulder. The design of these parts is such that each can expand freely, while the working forces are transmitted direct to the framing and the bed-plate. The outsides of the steel shells are galvanised, as a protection against corrosion, and the water space outside the shell is formed by a light removable jacket in the case of the top cylinder, and the inner walls of the entablature in the case of the bottom cylinder. On the bottom cylinder jacket there are large inspection and cleaning doors, which give access to the water spaces. The scavenge air is led to the cylinder ports and the exhaust gases are led away from the cylinders to the exhaust pipe by suitable passages, the castings being

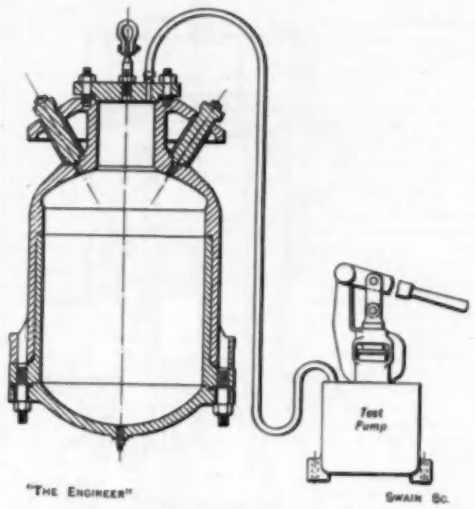


Fig. 9—Method of Removing Liner

so disposed as to be entirely unaffected by the working forces of the engine.

A useful feature of the cylinder design is the provision whereby the top cylinder with its jacket and clamping ring can be lifted off in one piece. After the rod has been disconnected from the crosshead the piston can then be withdrawn, and after the lubricating oil adaptors have been unscrewed the intermediate part of the liner can be lifted out. By unscrewing the bottom valves the bottom cylinder may then be lifted out from its casing. The total time for such complete dismantling is, we are informed, not more than three hours, the services of only four men being required. Another useful feature of the design is the possibility of exchanging a liner at sea should such a course be necessary. To do this a special cover is employed. It is secured to the bottom of the liner flange by studs screwed into holes which ordinarily form part of the water passages—see Fig. 9. The cylinder can then be filled with water and a hand-operated test pump employed to raise the pressure to about 550 lb. per square inch, which is generally sufficient to start the liner, in spite of the fact

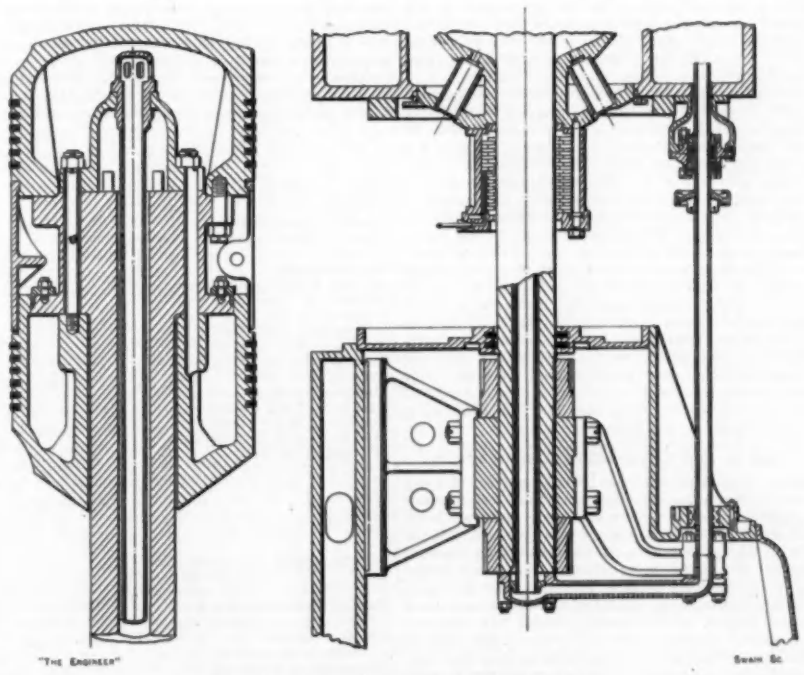


Fig. 8—Piston Cooling Arrangement

that, in machining, it is finished about four-thousandths of an inch oversize.

Reference may here be made to the disposition of the top and bottom fuel valves. The top valve has five fuel jets and each of the two bottom valves have two jets, which are directed away from the piston-rod. In the bottom cylinder the fuel can travel about 10in. without encountering any surface, and the flame does not impinge

either on the rod or the cylinder walls. As will be seen from the sectional drawings given in Fig. 3, the valves are operated from the cam shaft by means of a simple arrangement of push rods for the top valves and levers and links for the bottom valves, ahead and astern cams being provided. On the centre platform there are lower platforms forming a well in front of each cylinder, on which the attendants can stand, in order to gain access to the fuel valves and their drives and the piston-rod packing glands.

Pistons and Piston Cooling.

In the engraving Fig. 8 we show an enlarged section through one of the main pistons, and alongside it the lower cylinder end and crosshead, which drawing illustrates the piston cooling arrangement. The piston itself is made in three parts. The bottom part is put in from below and it is fastened to a flange on the piston-rod by studs made of Monel metal. The top part of the piston also rests on the flange on the rod, and it is also held in position by short studs which are accessible from the outside before the two-piece centre skirt is put into place. The centre parts are held together by transverse studs. As may be noted from the drawing, the cooling water passes up the central tube and enters the top piston near the crown. It then passes through holes in the flange to the lower piston and returns through similar passages to the air vessel on the top of the rod, leaving the piston through the bore of the rod. The special shape of the piston crown may be noted. It is provided with a deflector surface, which directs the scavenge air to the top of the combustion space. The bottom surface of the piston has four shallow hollows, which assist in forming the specially-shaped lower combustion space, which is indicated in the sectional views in Fig. 3. The very neat arrangement of telescopic tubes for conveying the water to and from the crosshead is clearly shown to the right of Fig. 8. The tubes are made from solid-drawn stainless steel bar and finished by grinding. White metal packings and rubber bands with intermediate scraper rings are used. The packing glands, which are attached to the chambers within the base of the cylinder, are shown in Fig. 8, and below each gland there is a water and oil thrower. These chambers are partly filled with air and the air supply is maintained by means of a small valve operated by a float. Other points in the design of this particular part of the engine to which attention may be directed are the plain piston-rod packing gland with its cast iron rings and the gland and plate on the top of the crank case, which prevents water or contaminated oil from gaining access to the crank case and the lubricating system.

Water Cooling and Lubricating Arrangements.

The cooling system throughout is arranged for the use of salt water, and a separately-driven cooling water pump is used. Apart from the piston cooling system we have already described, arrangements are made to cool the air compressor cylinder jackets and the interstage coolers, while a supply of cooling water is also given to the guide blocks, the main cylinder jackets, and the exhaust manifold. In order to maintain a head of cooling water, there are four standpipes, which pass through the exhaust pipe casing and are carried up to the height of the rails on the top platform. They are shown in Fig. 3. Another view of the top platform, in which these pipes are not shown, is reproduced in Fig. 4, and it indicates the very neat arrangement of valves and the fuel and the starting air piping. At the front of the platform and immediately below it there are large inspection doors, which give access to the scavenge air ports, and in one of these a glass window was arranged on the test with internal illumination so that the scavenge ports and the piston could be observed while the engine was running. The lubricating system is also served by a separately-driven oil pump, and it is complete with the usual filters. The liners, piston-rod packings, air compressor, and scavenge pump are lubricated under pressure by means of eight and ten-point automatic lubricators of the "Delvac" type, which are arranged at the front of the engine and are driven from the fuel pump shaft. Each cylinder is lubricated at eight points around its circumference, and there are also oil connections to the piston-rod packing glands. The compressor and scavenge pump lubricators supply both the cylinders and valve gears. The bearings are lubricated from the main pressure system.

Air Compressor and Scavenge Pump.

In Fig. 10 we reproduce drawings of the air compressor and the scavenge pump. The air compressor, which is shown to the right of our illustration, is of the three-stage pattern with inter-stage cooling. The piston has a trunk guide and the high-pressure piston is let into the crown of the second and third stage piston and secured in such a way that there is no danger of its being fractured by tilting when being placed in or withdrawn from its position. In all three stages loose liners have been used. A comparatively high piston speed of 400ft. per minute is employed, and for this reason a mechanically-operated 1¾in. diameter suction valve is used on the first stage, which, as shown, is driven by a plunger and lever operated from the cam shaft. The first-stage delivery valves are of the double-ring type, there being five valves, each with one-tenth of an inch lift. The second-stage valves are two in number and they are of the same type and are housed in a separate valve casing. For the third stage ordinary ring valves are employed. The first and second-stage intercoolers are arranged concentrically in a common water jacket and have small diameter cupro-nickel tubes. In the high-pressure or third-stage intercooler there are two solid-drawn steel tubes instead of the more usual copper coils, and the tubes are galvanised for use with sea water. The compressor, we noted, worked very coolly and silently, and typical pressures and temperatures are given in the table below. As the left-hand view in Fig. 10 shows, the scavenge pump consists of two double-acting tandem cylinders with Corliss valve gear for the inlet and outlet ports. The two pistons of the pump are offset by 90 deg. so as to produce a more uniform flow of air through the scavenge air manifold. It may be remarked that the lower piston is made solid, so that it has a balancing effect, while for the top piston a lighter construction has been employed. As previously mentioned, the pump is provided with mechanical lubrication, and we found it comparatively silent in operation. A useful feature is the provision of a specially strong cylinder cover, which will take the weight of a cylinder should it be necessary for it to do so when opening up the engine.

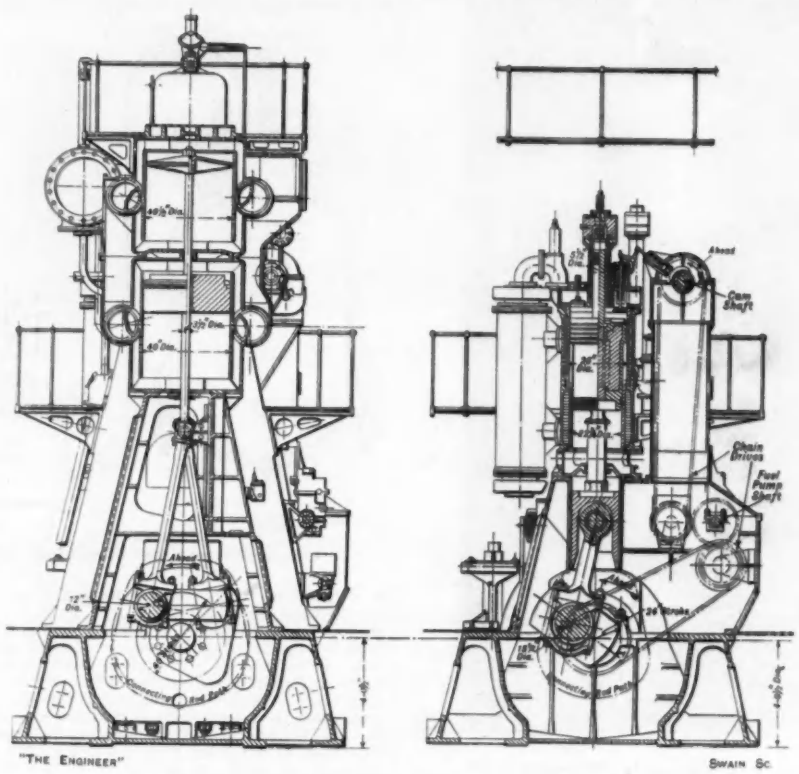


FIG. 10—SCAVENGE PUMP AND AIR COMPRESSOR

Starting and Manœuvring Controls.

The view of the front of the engine, which we reproduce in Fig. 5, shows clearly the arrangement of the fuel pump unit, the pressure gauges and the starting and manœuvring control gear. Provision is made on the fuel pump for cutting out the supply of fuel to any particular fuel valve by operating a small handle. The fuel pump controls are combined with those for the starting air, so that only a very simple arrangement of levers is needed. The lever on the extreme right below the fuel pump unit moves over a sector provided with a rack, and in consecutive positions first admits injection air to the air distributor, then starting air which actuates the automatic starting valves and puts the engine in motion, and, finally, after cutting off the supply of starting air, admits fuel oil to fuel valves.

The lever at the centre, alongside the valve block, is for reversing, and it controls the supply of compressed air to the servo-motor, which, by turning the fulcrum shaft frees the rollers from the cams, and slides the cam shaft along into the ahead or astern running position as desired. The lever to the extreme left operates the fuel valve and the supply of fuel to the two forward cylinders of the engine. When manœuvring continuously, the supply of fuel is cut off from the two forward cylinders, although the supply of starting air is retained. Under these conditions the engine runs in fuel on two cylinders only and starts and manœuvres on four cylinders. This arrangement, which has been tried on the American motor ship the "Steel Chemist," has proved most satisfactory, and it saves both fuel and injection air. In addition by-pass and blow-off valves are provided. The fuel pump is controlled by an "Aspinall" overspeed governor of the marine type. On the occasion of our visit to the works of Earle's Shipbuilding and Engineering Company, Ltd., the engine was running under full load, and we were impressed by the complete absence of vibration, both on the test bed itself and around it, and on the various platforms of the engine.

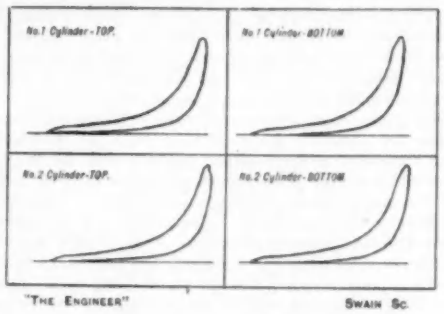


FIG. 11—INDICATOR DIAGRAMS

Trial Performance.

The engine has now been submitted to extensive bench trials, which included a ten-day non-stop test, about 16½ running days being occupied with the whole of the trials, which, we learn, have proved very successful. The principal fuel consumption trials were run on Monday and Tuesday, July 28th and 29th, and the particulars of these tests are given above. It will be seen that similar

Fuel Consumption Trials.

	July 28th	July 29th
Date of test		
Fuel used	Standard Diesel oil	Furnace fuel oil
Specific gravity of the fuel oil	0·860	0·926
Mean indicated pressure—Average top	85·2 lb./sq. in.	85·1 lb./sq. in.
Average bottom	83·5 lb./sq. in.	83·4 lb./sq. in.
Break reading	22·28 lb.	22·10 lb.
Amount of fuel burnt during the test	1006 lb.	1119 lb.
Deducted for recovered spill	2 lb.	1 lb.
Duration of test	62 min. 31 sec.	68 min. 30 sec.
Revolutions during test	6218	6710
Revolutions per minute	99·45	98
Total I.H.P.	2875 I.H.P.	2833 I.H.P.
Total B.H.P.	2216 B.H.P.	2170 B.H.P.
Total fuel used per hour	965·4 lb.	980 lb.
Fuel in lb./I.H.P./hour	0·335 lb.	0·346 lb.
Fuel in lb./B.H.P./hour	0·435 lb.	0·452 lb.
Fuel in lb./B.H.P./hour (metric)	0·428 lb.	0·445 lb.
Mechanical efficiency	77 per cent.	76·5 per cent.

	July 28th			July 29th		
	Pressures. Lb./sq. in.	Temperatures. Inlet. Deg. Fah.	Temperatures. Outlet. Deg. Fah.	Pressures. Lb./sq. in.	Temperatures. Inlet. Deg. Fah.	Temperatures. Outlet. Deg. Fah.
Air compressor—First stage cooler	32	279	101	34	289	102
Second stage cooler	172	261	97	178	283	100
Third stage cooler	850	327	98	865	350	99
Cooling water—Cylinders	14	91	127	14	92	140
Pistons	14	91	128	14	92	138
Lubricating oil	10·5		90	10·5		89
Scavenging air pressure	1·52			1·49		
Temperature of exhaust after leaving engine		505 deg. Fah.			517 deg. Fah.	
Colour of exhaust		Invisible			Invisible	
Compression pressure—Average top	467			467		
Average bottom	464			464		
Combustion pressure—Average top	554			550		
Average bottom	563			567		

tests were run with ordinary Diesel fuel oil and with an oil of boiler quality. Before beginning the tests the engine was run for close upon three hours, until steady temperature, speed, and torque conditions were established. The fuel oil was carefully weighed and readings on the Froude hydraulic brake were taken at five-minute intervals. Prior to the test the brake had been calibrated by the makers. A "Maihak" indicator, with a 360 lb. spring, was employed for taking the indicator cards, and, as shown by typical diagrams reproduced in Fig. 11, very similar cards are obtained from the top and the bottom cylinders. The indicator was driven directly from the crossheads by means of a system of long steel rods, which minimised the length of cord needed, and eliminated as far as possible any error which might be caused by the stretching of the cord. The indicator was attached to the cylinder jacket with a direct passage into the combustion space, so that no throttling took place.

Fuel Consumption Trials.

The full power and full speed trial was begun at noon on Wednesday, August 6th, and was continued without a single stop or hitch until noon on Saturday, August 16th. At the time of our inspection on Friday, August 8th, we found the engine running very well at a steady output of about 2175 B.H.P. at 98 r.p.m. The readings of the pressure gauges on the lubricating oil and water cooling systems were 7½ lb. and 17 lb. per square inch respectively, while the injection pressure was about 890 lb. per square inch, the three intercooler pressures being 30 lb., 165 lb. and 890 lb. The fuel used was Shell-Mex Mexican oil boiler oil, with a specific gravity of 0·926, and a viscosity of 200 seconds Redwood, which was specially chosen for this non-stop run in order to demonstrate the ability of the engine to utilise heavy fuel oils of furnace quality. During the progress of the trial the exhaust gases were analysed by the technical staff of the British Gas Light Company, Ltd., and the following composition was shown, there being no trace of carbon monoxide :—CO_2, 4·3 per cent.; O_2, 15·0 per cent.; N_2, 80·7 per cent.; total, 100 per cent. The exhaust was practically colourless, and the absence of carbon monoxide indicated the very complete combustion which was taking place. Toward the end of the period the compression pressures and the mechanical efficiency both slightly increased, and the engine seemed to improve in running as the trial proceeded.

The average readings were as follows :—

R.p.m.	98·07
B.H.P.	2140
I.H.P.	2790
Mechanical efficiency, per cent.	76·65
Fuel per twenty-four hours, in tons	10·35

According to the official report, which we have received, the engine when opened out after the trial was in very good condition. The cylinder liners had taken on an even and bright surface, were well lubricated on their surfaces, and were coming up to a very good skin. Examination of the cylinder liner ports should perfectly clean scavenge ports with only a slight accumulation of carbonised oil in the lower exhaust ports.

On removing the pistons all the rings were shown to be free and efficiently lubricated, while the centre part of the piston was evenly bright and was covered with a thin film of oil. Although a slight deposit of carbon was found adhering to the heads of the pistons, no trace of flame impingement, either on the cylinder walls, piston heads or piston-rods could, we understand, be detected. The piston-rod glands and packings were in quite good condition, and no scoring had taken place.

Special interest attaches to the examination of the telescopic tubes used on the piston cooling gear, as two different types of packing had been employed. Those tubes which were provided with a packing composed of white metal rings along with rubber bands showed no wear, the grinding marks on the tubes being still visible, whereas the tubes which were furnished with soft packing showed signs both of scoring and of wear. Both the air compressor and the scavenge pump were found to be in good condition, and no liner wear was indicated, while the valves were most satisfactory. In general, the running parts of the engine were in excellent condition, and an examination of the lubricating oil in the system showed that it was clean and free from water.

The engine designed by Mr. O. E. Jorgensen and built by Earle's Shipbuilding and Engineering Company, Ltd., under his supervision, has certainly made an excellent beginning in the matter of its workshop trials, and its further performance in extended service under sea-going conditions will be awaited with interest by marine engineers, shipbuilders, and shipowners. Meanwhile, the designer and the builders are to be congratulated on the satisfactory results which have been so far obtained.

The Russian Market for Machinery.

(By a Correspondent.)

A short time ago* the writer drew attention in this journal to the Russian market for machinery, with special reference to Soviet purchases from Great Britain and Germany. The information then given was based upon articles published in the Moscow *Economic Life* (*Ekon. Sjisn*). In the meantime, other articles have appeared in the same newspaper, abstracts from which may perhaps be worth perusal at the present time, although it is still necessary to accept with considerable reserve many of the statements which are reproduced.

In the first place, it is mentioned that the value of the machinery and plant introduced into Russian industries in 1912 amounted to about 400 million roubles, of which 45 per cent. was represented by imports. In 1913 the value increased to 500 million roubles, and in that year between 40 and 45 per cent. was obtained from abroad. At the present time, when an incomparably larger sum, it is claimed, is being invested in Soviet industries than in the pre-war period, the share of the imports in the general bulk of the machinery being absorbed by the industries scarcely reaches 25 per cent. whereas the foreign share in 1927–28 exceeded 33 per cent. The reduction in the foreign participation in meeting the requirements of the Russian market is ascribed to the development of the production of the native engineering works in Russia itself.

Among the European countries which import machinery and plant, not excluding England, Germany, and France, it is shown by statistics that Russia occupies the first place from the standpoint of the value of the imports, and that these imports apply mainly to the heavy industries. As a consequence, it is submitted that Russia is of enormous interest to countries which supply machinery and equipment and represents a specific attractive force to them.

The imports of machinery and plant for all branches of the Soviet industry are recorded as having amounted to 280 million roubles in the year 1927–28, as against 160 millions in 1925–26, and to 265 million roubles in 1928–29. On this point, the following list is quoted from the Russian Customs statistics concerning the value in thousands of roubles of various classes of plant imported in the years mentioned :—

Import Values in Thousands of Roubles.

	1926–27.	1927–28.	1928–29.
Internal combustion engines	1,824	2,704	4,519
Steam turbines	908	5,712	6,067
Rolling mill trains	475	636	1,407
Metal working machines	20,397	21,775	19,000
Pumps	3,442	5,187	2,399
Coal cutters	1,424	1,500	1,046
Excavators	1,845	296	653
Electrical equipment and motors	9,711	16,401	9,276
Transformers	3,029	5,721	3,151

Coming now to the question of the emancipation of Russia from the necessity for importing machinery and plant, which is the ultimate aim of the Soviet authorities, it must be mentioned that there is a tendency on the part of Russian writers in the native newspapers to put forward and accept estimates of proposed production within a given period as representing or as likely to represent the actual production of the native engineering works in that period. A typical example of this kind is shown in the following figures, which have been published to prove that the engineering production is now much greater than in the pre-war period. The figures are given in millions of roubles for the years 1912 and 1929–30, although the latter year will not expire until September 30th, 1930.

Russian Engineering Production.

	Millions of roubles. 1912.	1929–30.
Internal combustion engines	14·0	26·0
Steam boilers	7·0	27·0
Portable engines	2·5	8·0
Metal working machines	2·5	17·0
Woodworking machines	0·5	4·0
Pumps and compressors	8·0	13·0
Textile machines	6·0	41·0

Similarly, the production by the engineering industry of machinery and plant solely for industrial purposes is stated to have amounted to a value of 450 million roubles in 1927–28 and to have risen to 650 millions in 1928–29, while the value for 1929–30 is put at 1100 million roubles, although the year will only end with September this year, and for 1930–31 at 2100 million roubles.

What the Soviet Works are Producing.

It has already been stated that the reduction in the foreign percentage in meeting the requirements of the Russian market is attributed to the development of the production at the native works themselves. Besides the numerical augmentation in the output, it is claimed that an expansion is also taking place in the class and quality of the manufactures which are being turned out.

In the first place, it is mentioned that the works are successfully producing large generators of between 12,000 and 22,000 kilowatts, and are beginning to make generators of 44,000 kW, it not being desired to place orders for such machines abroad. It is considered that this measure of the production will permit in the present fiscal year—1929–30—of transferring the centre of gravity in the equipment of large electricity supply stations from the use of imported plant to the use of machines made at the native works. As in the case of large generators, so is the position, it is claimed, with regard to large turbines, which have hitherto not been previously produced in Russia.

The construction of high-pressure boilers—30 atmospheres—with heating surfaces up to 2500 square metres is stated to have been taken in hand at native works so as to effect a reduction in the imports. Oil break switches of up to 2500 kW are now being manufactured at the works of the Elektrosil in Leningrad, thus again avoiding the necessity for orders being placed abroad except when the question of time does not permit of the provision of native made switchgear.

Boring or drilling plants have hitherto always had to be obtained from other countries, but now Russian works have laid themselves out to produce these plants on a large scale, both for exploration works and for ordinary working activity. For the mining industry the works are turning out coal-cutting machines, conveyors, &c., although the output is far from satisfying the needs. In the case of Diesel engines a beginning was made some time ago, and the works are making arrangements for covering almost the whole of the demand, both for small units and for machines of up to 2500 H.P. In fact, the third Diesel engine of 2500 H.P. is reported to have been completed by the Baltic Engineering and Shipbuilding Works in June this year.

Hitherto there has been no production of coke ovens or of equipment for the metallurgical works or of petroleum refining plants, although in these instances also measures are being adopted with the object of diminishing the dependence of the country upon foreign imports. On the other hand, motor cars, tractors and bottle-making machines are also forming the object of production at Soviet works.

United States Trade with Russia.

Apart from the export trade carried on by Great Britain and Germany, to which reference was made in the previous article, a large share of attention has been devoted to the exports of the United States to the Soviet Union. The question not only concerns the export of machinery, but also what the Russian newspaper terms the "export" of technical knowledge and experience in the projecting and construction of works and machines, which paves the way for the introduction of American machinery into Soviet works. Moreover, as a result of the depression in European capitalist countries, it is considered that it will be impossible for American firms to reckon on any large growth in their exports to those particular countries, and that they have therefore turned in the past few years to the market in Russia, where the demand for American machines and equipment is growing.

In this connection it is stated that the orders placed by the Soviet authorities in the United States in 1927–28 represented 14·8 per cent. in value of the aggregate orders allotted to other countries for machinery and equipment in that year, and that this share rose to 35·5 per cent. in 1928–29, while at the same time the aggregate orders allocated to foreign countries considerably increased in that year. Moreover, the general volume of orders being placed abroad this year—1929–30—also shows a large advance over those in the previous year, and the geographical disposition of the orders is said to be determined by quality and conditions of credit.

It is considered that the growth in Soviet orders placed in the United States cannot but raise in a forcible degree the interest of American industrialists in the Russian market and in Soviet purchases. This increased interest is stated to be becoming all the stronger as the Russians on a wide front are acquiring American technical assistance and are utilising American consultants in connection with Soviet projects. In this connection it is pointed out that in 1929 Russia reached the second place in the export trade in tractors from the United States, of which 11,000 were received out of the total of 54,000 tractors which were sent out of the States in that year. The position is similar with regard to agricultural machinery, of which Russia imported machines of the value of 7·2 million dollars out of the total exports for 116 million dollars from the United States in 1928, and for 20 million dollars out of a total of 140 million dollars in 1929.

Coming to consider metal working machines, it is mentioned that among the foreign customers of the United States, Russia occupied the sixth place with an import value of 1,300,000 dollars out of a total of 34 million dollars in 1928 or 3·9 per cent.; the share of Russia rose to 10 per cent. in 1929 and is expected to be still greater this year. In the American export of constructional machines the share of Russia in 1928 was 7·5 per cent. of the aggregate United States exports of these machines; it increased largely in 1929 and the growth is continuing this year. Concerning machines for mining, metallurgy and the petroleum industry, it is claimed that Russia had a large participation in the American exports; it amounted to between 7 and 9 per cent. in 1928 and is said to have since been doubled.

* See The Engineer, June 13th, 1930.

Canadian Engineering News.

(From our own Correspondent.)

Big Flotation Mill.

A complete new mill, capable of handling 2000 tons of ore daily and incorporating the flotation system worked out by the company, is to be constructed immediately on the property of the McIntyre Porcupine Gold Mines, in Northern Ontario. This very significant change in the metallurgical operations of the company will involve the expenditure of a large sum of money. Adoption of the flotation system followed extensive experiments and the operation of a pilot unit, which demonstrated that improved metallurgical results could be secured on McIntyre ore. During 1929 the McIntyre mine treated 550,495 tons of ore, from which 213,292 fine ounces of gold were recovered, valued at 4,408,937 dollars, and 51,627 fine ounces of silver valued at 24,690 dollars. The cyanide process was used in treating the ore. In November, 1929, however, following laboratory experiments, a flotation unit of 200 tons capacity was installed. The flotation process was found to be highly successful in treating the ore. The cost of milling was shown to be less than in the cyanide process, and improved metallurgical results were obtained.

Power Plant Planned.

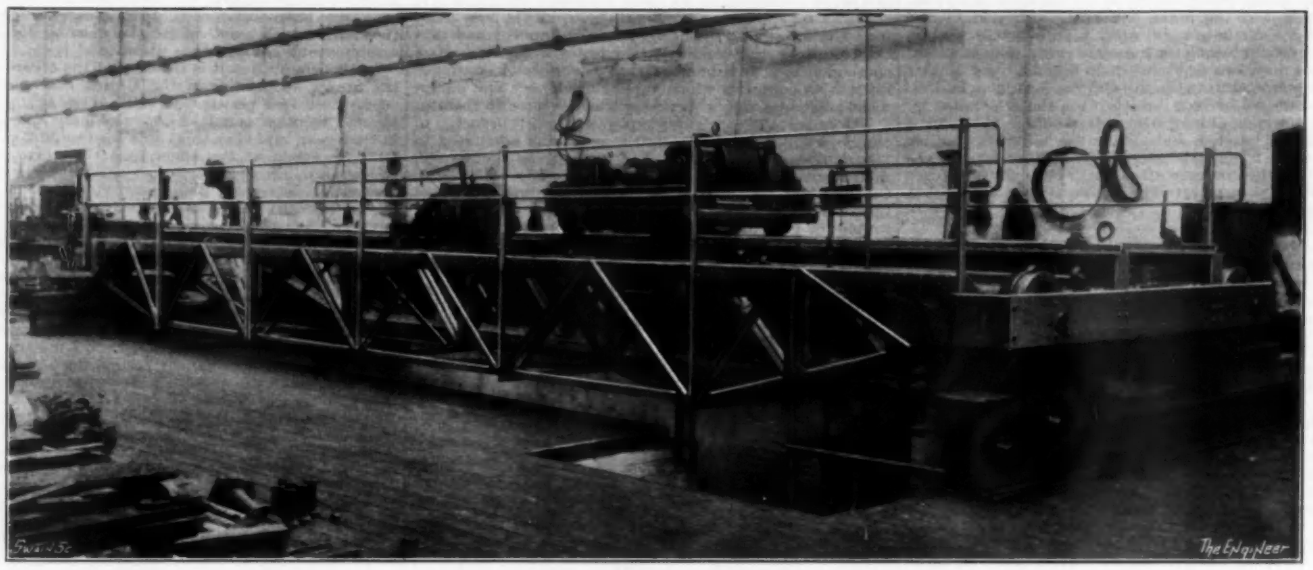
Intimation that the Ontario Hydro-Electric Commission purposes to erect in Toronto a new 220,000-volt electrical transformer station, costing about 6,000,000 dollars, has been given by the Commission. No date for the commencement of the work has been set, but it was indicated that the station would be similar to the one at Leaside, which receives power at 220,000 volts from the Gatineau plants. The new station is planned to take power for the Toronto district from the Chats Falls development on the Ottawa River, and the Beauharnois development on the St. Lawrence. These are two of the largest hydro-electric projects at present under construction in Canada.

The Rubber Industry.

An example of success in the building up of a manufacturing enterprise under difficulties is that achieved by the rubber industry of the Dominion. Drawing its raw materials almost entirely from other countries, this branch of manufacture has developed a scale of production, which not only supplies a large part of the home market, but is sending out increasing exports to all parts of the world. In a period of seven years this industry has increased its output by over 145 per cent., and its exports by over 165 per cent. Imports in the meantime grew by a little over 70 per cent., but there was a change in their character. At the opening of the period, 57 per cent. of the imports consisted of raw rubber, but at its close the crude material accounted for 80 per cent. of the imports. The latest returns available for the industry as a whole are for the calendar year 1928. The comparison made above is with the state of the industry in 1921, when business had returned to normal after the war. In 1921 the number of establishments engaged in the production of rubber goods in Canada was thirty-five. By 1928 it had increased to forty-five. In 1921 the capital invested in the industry was 54,237,618 dollars; in 1928 it was 70,459,066 dollars. The value of the products of the industry in 1921 was 39,469,786 dollars; by 1928 this had increased to 97,208,713 dollars.

5-TON OVERHEAD TRAVELLING CRANE

JOSEPH ADAMSON AND CO., HYDE, ENGINEERS



5-Ton Overhead Travelling Crane with Ball Bearings.

The accompanying half-tone engraving represents a 5-ton electric overhead travelling crane, which we have recently had an opportunity of inspecting under test at the works of the makers, Joseph Adamson and Co., Hyde. Although the main features of the crane are in accordance with standard practice, there are several points in the construction which call for special mention, the chief being the adoption of ball and roller bearings of the Hoffmann type for the running parts. The specification to which the crane was built demanded the following speeds :—Hoisting, 25ft. per minute ; cross traverse, 80ft. per minute, and longitudinal travel 350ft. per minute. The span is 46ft. 6in.; wheel base, 9ft. 5in., and the height of lift from the floor level 23ft.

The bridge is of the four-girder lattice type, having two main girders upon which the crab travels, each main girder being reinforced by auxiliary girders with cross members. Between each auxiliary girder and the main girder there is a chequer plate platform which contributes rigidity to the structure to resist horizontal forces when the crane is travelling, and gives a rigid connection to the carriages, so as to reduce cross-winding tendencies as well as to eliminate distortion of the longitudinal travel drive—an essential feature when roller bearings are employed.

The axles for the main runners in the end carriages are of the fixed type and of large diameter, the bearings being placed in the bosses of the runners to avoid distortion. The cross shaft connecting and driving one runner in each carriage is carried in swivel bearings to ensure accurate alignment, the endwise movement being taken by a locked bearing. To eliminate unnecessary handling the driving mechanism at centre of crane is designed to be taken out as one unit. A foot brake attached to this mechanism is of sufficient power to bring the crane to rest with an ample margin of safety after the current has been cut off. The hoisting mechanism consists of two reductions of spur gearing, the barrel and the intermediate bearings being of the swivelling roller type, while the bearing for the extension of the motor spindle is of the ball type. This motion is fitted with a powerful electric brake on the motor extension shaft.

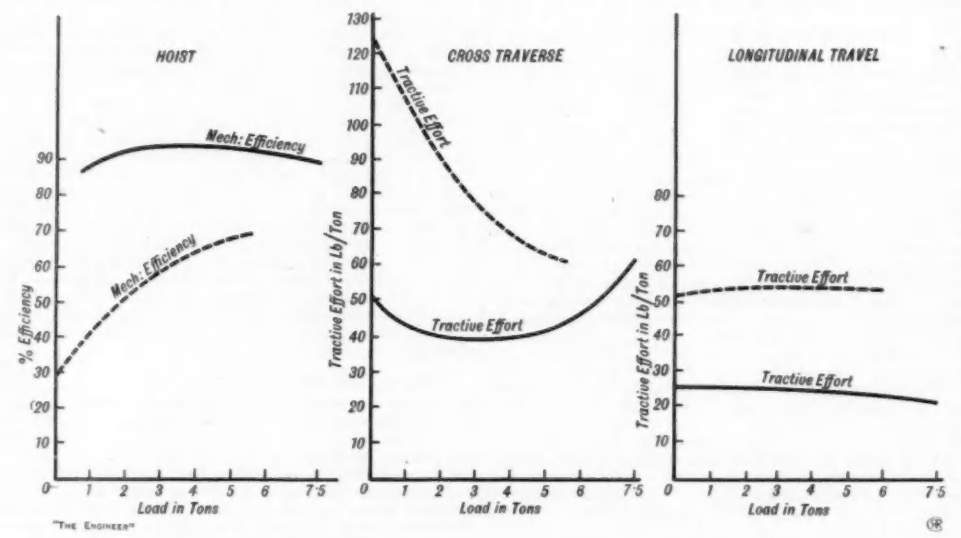
The cross traverse is driven by double reduction spur gears which drive two of the runners, and the bearings including those of the axles, but excluding the motor extension shaft bearing, are of the roller pattern. The extension shaft runs in a ball bearing and care has been taken to secure rigidity when cross traversing, and arrangements are made to take up the thrusts. This cross traverse motion is fitted with an electric brake, a necessary adjunct in view of the free running of this motion.

A recent minor development made by the firm is the method of running the cables in special troughing instead of in conduits. This enables the cables to be taken out or inserted in quick time, while possibility of damage is minimised. Another departure from existing practice in frame construction is the use of welding for non-stress bearing members.

In spite of its comparative lightness of construction, the deflection of the main girders under a 50 per cent. overload test is only $\frac{1}{8}$ in. The motors are of larger size than necessary for the power absorbed in order to secure interchangeability with others used on existing plant. They were supplied by Laurence Scott and Electromotors, Ltd., while the control gear was supplied by the Metropolitan-Vickers Electrical Company, Ltd., and the panel by Parmiter, Hope and Sugden, Ltd.

This being the first crane on which ball and roller bearings have been fitted throughout, much interest attached to a series of tests which have been conducted to ascertain comparative figures with a similar crane having standard bushed bearings, and the makers have supplied us with a set of diagrams showing how the two cranes compare. Curves for hoisting, cross traversing and for the longitudinal travel of the two cranes are given in the accompanying diagram, the ball bearing crane curves being shown by full, and the bushed bearing crane curves by broken lines. Without going into full particulars it may be briefly stated that with the ball and roller bearing crane at full load the power absorbed when hoisting is about 32 per cent. less than that taken by the standard crane, when cross traversing about 35 per cent. less, and when travelling 57 per cent. less, while under average conditions of operating the economy in power is between 33 and 50 per cent. The overall mechanical efficiency of the hoisting motion is about 94 per cent. and the tractive effort approximately 25 lb. per ton under the nominal working load of 5 tons on the longitudinal travelling motion and 40 lb. per ton on the cross traversing motion.

It is claimed that with this crane both running and maintenance costs are reduced and, what is frequently of prime importance, greater cleanliness, both of the crane and the shop, is attained.



PERFORMANCE OF BALL BEARING AND BUSHED BEARING CRANES

South African Engineering Notes.

Manganese Shipments Begin.

Three small cargoes of manganese ore from the Postmasburg manganese field were recently shipped from Durban, and from now onwards big shipments are to be made, and at least two steamers, carrying 4000 to 5000 tons each, will be dispatched weekly. Later on the output from the mines will be greatly extended. All arrangements for large and regular shipments have been made, and in about two years the Managanese Corporation hopes to open manganese works where the ore will be treated and turned into ferro-manganese. The loading plant at Congella is of the most modern type and will be capable of handling 500 tons of raw ore an hour. The storage capacity will be 50,000 tons or more. The estimate is that within two years the weekly shipments will reach about 20,000 tons, so that the shipping company which succeeds in obtaining the contract to carry the ore will be fortunate.

Rich Big Copper Mine.

The outstanding feature of the developments in the Northern Rhodesian copper field during recent months has been the remarkable ore disclosures obtained in that portion of the Rhodesian Congo Border Concessions which immediately adjoins the N'Changa Copper Mines, and somewhat to the west. It is considered certain that before long the R.C.B.C. will be found to possess the richest big tonnage copper mine in the world. In the property referred to, best known perhaps as the N'Changa extension, numerous bore-holes have demonstrated the existence of from 40 to 50 million tons of ore averaging from 8 to 10 per cent. copper. The probabilities are that those figures will, after more work has been done, be found to be of a conservative nature. There is every likelihood that within the next couple of months an ore zone containing approximately 100 million tons of ore of an average value of nearer 10 per cent. than 8 per cent. will be indicated. A large proportion of the ore is, it is stated, clean sulphide, and it is deemed to be not unreasonable to assume that the management of this remarkable mine will be able to put copper on the markets of the world at £22 per ton of metal.

Vereeniging Power Station.

Having secured parliamentary powers to extract more circulating water from the Vaal River, the way is now clear for extensions at the Vereeniging power station from the present installed capacity of 50,000 kW up to an ultimate capacity of 136,000 kW. The first step in this expansion is shortly to become effective by the installation of the largest turbo-alternator in South Africa, a unit rated at 32,500 kW and 40,000 kVA, operating at 3000 r.p.m. The various parts of this set were delivered at Vereeniging before the end of July, and it is hoped to have it erected and ready for load by September. A new boiler-house is being provided to furnish the necessary additional steam, but so far the only additions to be made are two 60,000 lb. "B. and W." boilers, hitherto in operation at the Alice-street station of the Durban Corporation, rendered available owing to the Electricity Commission having taken over the greater part of the Durban load at its Congella station. The new boiler-house is so designed, however, that it will accommodate boilers with a normal rating of 160,000 lb. per hour. Such boilers would be by far the largest ever installed in South Africa. The turbine-house has been lengthened by 90ft., and is thus capable of housing another large unit, in addition to that now under erection.

Big Irrigation Projects.

It is stated upon good authority that irrigation schemes in the Marico, Bosveldt, Schweizer-Reneke and

Maquassi districts of the Transvaal and at Nqwaleni in Natal, are to be initiated shortly by the Department of Irrigation. It is understood that as the result of a round-table conference between the officials of the Department, a sum of £390,000 is to be expended on these four schemes this year from the amount voted for irrigation purposes. The most important of the schemes is that on the Marico River where £230,000 is to be spent this year on preliminary work. On the Schweizer-Reneke scheme a sum of £42,000 is to be spent, and at Maquassi and Nqwaleni £25,000 will be expended in each case.

Victoria Falls Bridge.

The widening of the Victoria Falls Bridge has now been completed. It was reconstructed for the Rhodesian Railways by the Cleveland Bridge Company, Ltd., and the consulting engineers were Sir Douglas Fox and Partners. Before the bridge was widened, motorists had to truck their cars and detruck them at Livingstone, which invariably meant a delay of at least a day before they could proceed further. All that is now done away with. The difficulty of the task lay in removing the whole of the former deck without interrupting railway traffic, except at certain periods. The track had first to be raised by 4ft. 7in., and the old deck was removed in sections of 25ft. at a time. The work was all done without any serious disturbance to traffic. The removal took just over four months, after which the widening process was completed, the bridge strengthened and a roadway added. The old deck was 30ft. wide and took a double line of rails and a footpath. The reconstructed bridge has an overall width of 43ft., with a railway track and a roadway of concrete on troughing with a 2in. thickness of asphalt macadam. There is also a 9ft. wide footway.

Rhodesian Railways.

For the six months ended March 31st the gross earnings of the Rhodesian Railways amounted to £2,697,477, an increase of £384,770 on the corresponding period for 1928–29. The total gross operating expenditure was £1,777,411, or an increase of £343,210, and the net operating revenue amounted to £920,066, an increase of £41,560. The number of passengers carried during the six months was 476,162, an increase of 67,825; while the revenue showed an increase of £29,578. The coal and coke tonnage carried for the six months was 508,078 tons, being an increase of 76,446 tons. The principal increases were railways 38,237 tons, Union Minière 29,793 tons, and for the general public of Rhodesia and Mozambique Territory 13,213 tons. There were heavy consignments of chrome ore, the total of 161,893 being more than twice the quantity for the corresponding period of the previous year. Asbestos increased from 17,633 tons to 24,481 tons, while copper consigned for export rose from 24,125 tons to 41,583 tons. The quantity of zinc carried continues to be appreciable, the total for the six months being 9430 tons, as against 6324 tons for the corresponding six months of the previous year. Large quantities of rolling stock are now being shipped, or are due for delivery, including six locomotives for Vryburg–Bulawayo section, and about 500 wagons of different types are still due from contractors. A petrol-electric crane on caterpillars has been provided at Bulawayo goods yard, and is giving very satisfactory service. It eliminates a certain amount of shunting. Instead of having to wait for an engine to move trucks under a fixed crane, the moveable crane can be run direct to the truck and take its load from there to any other point in the yard. This crane was supplied by Ransomes and Rapier, Ltd., England, and is an entirely self-contained unit, with a lifting capacity of 6 tons.

Sloan Wire Pack.

The Sloan wire pack is the latest type of support for underground workings to receive recognition, and it has now passed the experimental stage, and several mines are using it on the Rand. Though the big producers of the Far East Rand, such as the Government Areas, Van Ryn, and New Modder, have not yet adopted the wire pack itself, being still committed to the merits of the concrete pack, they are using the Sloan wire fencing, which is of single-strand and lighter than the bird-cage mesh, as containers for their sand filling, with satisfactory results. It would appear therefore that at last a suitable means of withstanding ordinary and excessive pressures—where the onset is gradual—at a low cost has been discovered, and those mines, especially in the Near East and Central Areas, which have hitherto stood aloof, will, it is thought, adopt it, and thus effect a big saving in their timber bills. It is claimed that the Sloan pack is both cheaper and more durable than the pig-sty, and the claim seems well founded. As the concrete pillar, in slab form, has come into a good deal of favour, it is interesting to compare the respective costs of the three forms of support. The cost of a pig-sty, 6ft. square, which requires about nineteen 8ft. laggings, is £2 8s. 6d.; the cost of a concrete support works out at £1 7s. 9d.; while the cost of the Sloan pack is £1 3s. 8d. There is therefore a saving on the cost of a pig-sty of £1 4s. 10d., or 51 per cent., and on concrete 14 per cent. The wire pack is lighter and less bulky, and has the advantage of easy and expeditious handling and rapid transportation at a much lower cost. The only timbers used in the construction of a Sloan pack are the three props set up on its underside to keep the pack in position; when it starts to take weight, the props can be removed, and used over again. Other advantages claimed for this pack over the pig-sty are its complete immunity from fire, longer life, greater ability to withstand the effects of blasting, and the larger and more permanent area of support it offers to the hanging and footwall.

FLIGHT CADETSHIPS AND SCHOLARSHIPS AWARDS.—The Air Ministry has announced that Aircraft Apprentices T. G. L. Gale, S. J. Marchbank and R. A. C. Carter, from No. 1 School of Technical Training (Apprentices), Halton, have been selected for cadetships at the Royal Air Force College, Cranwell, on the result of the examinations held on completion of their three years' training as aircraft apprentices. "Sir Charles Wakefield" Scholarships valued at £75 each have been awarded to Flight Cadet D. R. Shore, on the result of the recent competitive examination for entry into the Royal Air Force College and to Flight Cadet T. G. L. Gale.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

THERE is no material change in the general situation in the iron and steel and heavy engineering industries of the Midlands and Staffordshire on the week, but the brighter spirit is maintained, and the weekly meeting in Birmingham was well attended. Actual transactions are still disappointing, but prospects are considered by many to be slowly improving. Furthermore, inquiries are more numerous than of late and they relate to larger quantities of material than users have been accustomed to purchase during recent months. Though it cannot be said that there are evidences of an immediate trade revival, there can be but little doubt that "things are on the mend." Manufacturers are consequently closely watching events and preparing for the hoped-for buying movement.

Raw Iron.

Some buying of foundry and forge pig iron continues, but it is insufficient to keep down stocks at furnaces, which are growing considerably. Even those producers in Derbyshire who have been least affected by the slump in buying are now becoming anxious about the outlook. In the Midland district, which comprises Staffordshire, Shropshire, Worcestershire and Warwickshire, there are twelve out of forty-four blast-furnaces at work. This is the same number as a year ago. They are engaged largely in the supply of associated plants and in turning out special qualities of pig iron for the service of district industries. The ironfoundries of the Black Country are slack just now, and the needs of the wrought iron trade are easily supplied. Smelters note with growing anxiety the number of furnaces being "blown out" throughout the country. Last month twenty-eight blast-furnaces ceased operations, leaving only 105 active, against 159 at the beginning of the year. Furnaces producing basic pig were the first to be reduced in number, and later came drastic measures to stop the overproduction of hematite. In the forge and foundry department curtailment has proceeded more slowly. Of the furnaces withdrawn from active service during July three were in Lancashire and Yorkshire, two in Derbyshire, Leicestershire, Notts. and Northamptonshire district, four in Durham and Cleveland, three in South Wales and thirteen in Scotland. When furnacemen look at the trade returns they find an equally disquieting state of affairs. Taking the expired seven months of the year, exports of pig iron amounted to only 182,906 tons, against 282,166 tons during the corresponding period last year. On the other hand, imports of forge and foundry pig were not very far short of four times as large as those of the corresponding months in 1929, while the imports of basic were nearly thrice as large. Midland smelters are worried as to the future and are eager to see evidences of the normal autumn expansion of demand. Selling values as fixed by the Producers' Association are unchanged, Derbyshire No. 3 foundry being £3 13s. 6d. and Northamptonshire £3 10s. Forge materials are £3 8s. 6d. and £3 5s. per ton respectively.

Steel.

Conditions in the steel trade continue unsatisfactory, demand being exceedingly poor all round. Orders for structural material are small and difficult to secure, while general engineers appear to have little need of material. The trade stands very much in need of a fillip. Though some merchants report improved buying, producers generally refuse to accept this, stating that, for their part at any rate, they have not felt any new impulse in buying. Foreign aggression does not seriously affect the constructional branches, which are protected by the rebate scheme. Most of the large consumers are associated with the scheme and they appear to be standing by native producers just now. Prices in this branch are unchanged, angles and joists are £8 7s. 6d. and £8 10s. respectively, and plates, 3in. and upwards, £8 17s. 6d. It is in the re-rolling field that home producers are feeling the pinch. Consumers are watching the market very closely and hesitate to make purchases lest they should make a mistake. Local steel re-rollers cannot put small bars on the market, even when rolled from imported billets, under £7 15s., and that is considered too low a price, whereas bars of foreign make are delivered here at from £5 12s. 6d. to £5 15s. For all-English bars the steel works want from £8 5s. upwards, though that figure might be shaded for an attractive line. The district price of tube strip—£8 upwards—is from 20s. to 25s. higher than the continental price. English makers of billets of ordinary rolling quality are reluctant sellers at £7 15s. and generally ask 2s. 6d. more. Some business has been done in continental billets at the declared minima of £5 5s. 6d. for 2in. and £5 4s. 6d. for 2¼in. upwards, though these figures are said to have been shaded. The basis for foreign sheet bars, which was fixed at £5 8s. 6d., has not been effective. Supplies are obtainable at from 2s. to 2s. 6d. below the official rate.

Finished Iron.

Staffordshire makers of marked bars continue to receive a steady flow of orders, and the quotation of £12 10s. at makers' works, which has existed for twelve months, holds good. Inquiry for Crown bars, on the other hand, is small and fitful, and present indications point to a continuance of broken time and irregular working programmes. Makers express disappointment that the holiday stoppage, extending to a fortnight in some cases, did not produce more work. Such transactions as do take place are based upon £10 to £10 7s. 6d. Sales of common bar iron are insignificant, this branch being dominated by Belgian competition. Demand for chain and cable iron is also at a low level. A substantial output is being made in the nut and bolt trade, but competition is reported to be severe and prices are low. Wrought iron tube strip sells fairly freely at £11 2s. 6d. per ton. Consuming works in this area are moderately well employed.

Galvanised Sheets.

Despite the fact that there have recently been inquiries from several overseas markets for galvanised sheets and that they have been withheld on account of the price asked, makers had no hesitation last week in reaffirming the basis for 24-gauge corrugateds at £11 17s. 6d. per ton f.o.b. It is pointed out that makers have to pay from £5 15s. upwards for their sheet bars of English make and in the neighbourhood of £5 6s. for continental bars. Profitable production, therefore, could not be maintained were millowners to reduce their charges. Business at date continues on the quiet side, and, as is evidenced by the fact that delivery dates are now much nearer, mills are overtaking commitments faster than they are being replaced. An early improvement in demand is anticipated, and the retaining of the late basis price is expected to add confidence to the market.

Midland Contracts.

Some useful orders have recently been secured by Midland firms. The Metropolitan Cammell Carriage, Wagon and Finance Company, Ltd., of Birmingham, has received an order for fifty four-wheeled covered goods wagons, metre gauge, of the M.A. 3 type, for the Bhavnagar State Railway. The General Vehicle Company, Ltd., of Tyseley, Birmingham, is to supply an electrically driven tower wagon at £956; and Edgar Allen and Co., Ltd., are to provide tramway special trackwork at £1130 to the Liverpool Tramways and Electricity Committee. A message from abroad states that a contract for the supply of twenty 10-ton petroleum tank wagons, tenders for which were recently called for by the Egyptian State Railways, is to be awarded the Birmingham Railway Carriage and Wagon Company, Ltd., of Smethwick, at the price of £329 (Egyptian) per wagon. The Great Western Railway has recently placed an order for the renewal of a swing bridge over the Bute West Dock lock at Cardiff with the Horseley Bridge and Engineering Company, Ltd., Tipton, Staffordshire.

Railway Schemes.

The London, Midland and Scottish Railway improvement schemes which are to be carried out in the winter at a cost of some £2,600,000, include the widening of lines at several key points between Bromsgrove and Stoke-on-Trent, which will greatly facilitate traffic between the Midlands and the North and the West of England. Goods terminal accommodation is to be improved at important centres, such as Birmingham, Great Bridge, and Stoke. The Great Western Railway intends to widen its Paddington and Birmingham main lines between Bentley Heath level crossing and Rowington Junction (Warwickshire).

Trade Returns.

Midland industrialists express qualified pleasure at the trading returns for July. These show that the total exports of iron and steel and their manufactures advanced from 250,969 tons in June to 303,444 tons in July. There was an appreciable rally in steel bars, hoops and strip, plates, galvanised sheets, tin-plates, wrought tubes, pipes and fittings and wire. Nevertheless, it is borne in mind that in all those categories the turnover was less than in the previous July. The tonnage of iron and steel imported in July was smaller than in June, and it is not without significance that the declining tendency showed itself in nearly every department of the trade except that comprising steel billets and blooms. There the actual tonnage was rather larger, but taking into account the greater number of working days in July, the volume of trade was relatively less.

Chain Trade.

There is very little activity in the chain trade in Staffordshire and Worcestershire at date. The position in all sections of the industry is unsatisfactory, and unfortunately there is no prospect of an improvement until the shipping industry revives. Engineering and colliery chain is not being bought to any extent, and the cheaper grades are meeting with keen continental competition.

Coventry Engineering.

Rather more activity is this week discernible in some sections of the Coventry automobile industry. In some important instances toolroom staffs are working night shifts preparing jigs and other machine tools for the coming season's campaign. Firms engaged in electrical engineering report that business in the radio section has increased very considerably during the past few weeks and that the outlook is promising.

Unemployment.

The most recent unemployment returns for the Midlands area, which relate to the position on August 18th, show that both in the area as a whole and in Birmingham there has been a decided and welcome decrease. In the Midlands the reduction amounted to 21,367 and in Birmingham there were 383 fewer unemployed. The present totals in the various towns are:—Birmingham area, 53,308; Bilston, 4559; Coventry, 13,206; Cradley Heath, 6777; Derby, 5420; Dudley, 5173; Leamington, and Warwick, 1222; Leicester, 14,574; Northampton, 5017; Nottingham 12,643; Oldbury, 1780; Peterborough, 733; Redditch, 2030; Smethwick, 5091; Stoke-on-Trent, 32,107; Stourbridge and Brierley Hill, 4975; Tipton, 3085; Walsall, 8433; Wednesbury, 3390; West Bromwich, 4261; Wolverhampton, 12,764; Worcester, 1851. Of the grand total, 197,313 are men, 84,271 women, 7508 boys, and 7349 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Bridging the Dee.

IN the middle of July it was announced in this column that a conference of authorities directly interested

would shortly be held in Liverpool to consider the feasibility of constructing a road across the river Dee from West Kirby, on the north-west of the Wirral peninsula of Cheshire, to Point of Air, on the North Wales side. If and when this conference takes place another scheme with this end in view, the outline of which has been given during the past few days, will have to be considered. The latest plan has been put forward by Mr. T. R. Wilson, of London, who proposes to utilise the hydraulic fill method of constructing the embankment, the "sands of Dee" being packed between two stone containing walls to a height of 80ft. to meet a bridge of thirteen spans, each of 330ft. in length. The proposed bridge would carry a double railway track and a roadway. The distance between the two points is about 6 miles, and the cost is estimated at £3,000,000, or roughly half the cost of the plan put forward five years ago, the essence of the latter being to utilise the *débris* excavated in the course of constructing the new Mersey tunnel now approaching completion. The opinion of Mr. F. Webster, Lecturer in Civil Engineering at Liverpool University, is that Mr. Wilson's scheme is the best that has yet been put forward, and that the time may have come for such a project to be attempted. As has previously been pointed out, it would mean a very substantial reduction in the present 30 to 40-mile journey from the Wirral Peninsula to North Wales *viâ* Chester.

Refining Rhodesian Copper.

Liverpool's efforts of recent years to attract new industries to the Merseyside area have met with a large measure of success, and rumours are now current regarding the likelihood of establishing a refinery at a cost of £2,000,000 to deal with Rhodesian copper ores. Beyond this, little more can be said at present, though it is known that negotiations have been going on for some time. About two years ago what was claimed to be the largest tin-smelting plant in the world started operations in the Liverpool district.

Order for Omnibus Chassis.

Glasgow Corporation has placed an order with the Vulcan Motor and Engineering Company, Ltd., of Southport, for twenty-five chassis for double-decker motor omnibuses.

A Locomotive Shop Repair Record.

A record in locomotive repair work is claimed by the Horwich works of the London, Midland and Scottish Railway Company. The complete dismantling, overhauling, and fitting of necessary new parts have been carried out on a goods engine of the 0–6–0 type in 26 hours 35 min. working time, or 10 hours, 25 min. less than the previous record held by the St. Rollox Works, Glasgow.

Non-ferrous Metals.

All sections of the non-ferrous metals market during the past week have experienced a trying time, prices having declined to such an extent, as, in almost every instance, to wipe out the whole of the recovery made during the past few weeks. In the copper section, the statistical position continues to operate against any upward trend and buyers are taking very small quantities of the metal, the turnover in the past week having been exceptionally poor. The decline in quotations has not in itself been severe, but, nevertheless, it has been sufficient to bring prices down to what is probably a new record "low." Stocks of tin held in this county are steadily increasing, and although up to the close of last week this factor had not resulted in any fresh weakness, the early days of the present week saw the decline develop and on balance there has been a loss of rather more than £2 a ton, current values being lower than since the middle of July. The demand for lead has been relatively good, but in spite of the fact that supplies are not excessive the metal has been unable to withstand a sympathetic decline to about 5s. below the level current a week ago. Spelter is cheaper on the week to the extent of 10s. a ton, prices having touched a new low level. The demand has been very moderate and no improvement is yet in sight.

Iron and Steel.

Inquiry for foundry iron on this market is restricted, and users are taking only about sufficient of the material to carry them over the next few weeks, conditions at most of the foundries in the county being very unsatisfactory, with deliveries affected in consequence. Quotations are maintained, however, at 72s. per ton for Staffordshire makes, about 93s. for Scotch, and 87s. for West Coast hematite, all delivered equal to Manchester. Bar iron is steady at £10 5s. per ton for Lancashire Crown quality material and about £8 15s. for seconds, but sales in the aggregate are only very moderate. In the steel market, complaints are general as to the paucity not only of new bookings but also of the tonnage covered by current contract specifications, all branches of the engineering trades—constructional, textile machinery, boilermaking, and locomotive building—taking only small quantities into consumption. Quotations are maintained, however, at £8 10s. per ton for joists, £8 7s. 6d. for sections, about £9 15s. for acid and basic boiler plates, £8 17s. 6d. for general plates, £9 7s. 6d. for large bars, and from £7 17s. 6d. to £8 for small re-rolled bars. The demand for continental steel is slow and prices are easy.

BARROW-IN-FURNESS.

Hematite.

The West Coast hematite pig iron trade continues to be very dull indeed, and there is not a single bright spot in it. General demands are very thin indeed, customers only taking small tonnage to keep them going. The local demand is down considerably, owing to complete idleness in the rail mill at Barrow, and less than half production at the railway material departments in Cumberland. Continental and American business is flat and has been quiet for many weeks now. This slump in business means that much pig iron is going into stock, and that when idle pig iron reaches a certain tonnage, furnaces will go out and remain out until it has been cleared. In the past when stocks have accumulated, there has on occasions been a clearance to America, usually *viâ* Philadelphia, but no business has been reported as yet in this direction. Iron ore is quiet, with a poor outlook, and the steel market is dull. The Barrow rail mills are idle, and at Workington they are only working two weeks in the month.

Shipbuilding.

On Tuesday, Vickers-Armstrongs, Ltd., launched from their shipyard at Barrow the motor vessel "Otaio," for the New Zealand Shipping Company. She will be fitted with Messrs. Doxford's opposed-piston airless injection engines, two sets, driving twin screws, giving a total of 9400 B.H.P. at 120 r.p.m.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel No Better.

THERE is no improvement to report in the open-hearth steel trade of this district; in fact, the situation is worse rather than better. The consumers' policy of ordering for immediate requirements only, which they have been pursuing for the last two or three months, is still maintained. Billet makers state that there is practically no forward booking, and that the outlook for the future is very unsatisfactory. There is usually a revival of buying in September, and it is hoped that this will soon show itself, as stocks in the hands of steel users must have dwindled to a very low point. Of the total open-hearth furnace equipment available in the district, only about a quarter is at work. At the great establishments of the United Steel Companies at Templeborough and Rotherham only six furnaces are in operation. There is much slackness at the same combine's strip and bar mills and wire rod mill, and at the Stocksbridge works. The quietude in the ship-plate trade is affecting the Appleby works. The position at the Lincolnshire steel works as a whole continues bad, and is in marked contrast to the activity which was maintained up to a few months ago. Another of the great works in that area extended its holiday stoppage to a third week.

The Manufacturing Side.

Work for the railway companies, on axles, tires and springs, is only moderate in amount, and the outlook is not promising, in view of the severe economies which the companies are practising. Some comfort is to be found, on the other hand, in the fact that the building of privately owned wagons is being resumed, after the trade had been suspended for several years. In the finished steel sections generally the depression is less acute, but while some firms are able to report the arrival of very fair orders, others are short of work, and there is hardly any branch which can be said to be busy. A certain amount of valuable work has been temporarily held up at the request of the buyers. The production of stainless and corrosion-resisting steels is on a large scale, and a valuable amount of work still comes from the motor industry, although its requirements tend to shrink. The most active branch is that which supplies materials for electrical engineering. That industry has almost escaped the depression which has been ruling so long, and is purchasing steel goods on an increasing scale. The depression is affecting makers of engineers' tools, but they are able to maintain a certain amount of activity. There is much shortage of work at all the rolling mills.

Cutlery and Plate.

The cutlery and plate trades, although still turning out a large volume of goods, are not by any means busy. Conditions have been unsatisfactory for a long time, and although some improvement in activity has been noted lately, the output for August was considerably below that of the corresponding months of previous years. Short-time working, if not the invariable rule, is fairly general. In normal times, buying for the Christmas season trade with Australia and New Zealand would now be in full swing, but it is below the average, and it is a considerable time since any weight of new business was booked from those markets. Trade with the home market, through ordinary shopkeeping channels, is very slow, but the demands of the catering trade grow year by year, and good orders continue to come in from that source, so that there is a steady, though not large, call for knives, forks, and spoons. The ordering of goods for distribution as advertisements, which was on a very large scale, towards the end of last year, has not kept up to a high level latterly, but it is now improving. Among the articles required for this purpose are considerable quantities of pocket knives. The trade in safety razor blades, which up to a few months ago had shown a constantly expanding tendency, has since fallen away to a notable extent. Many of the girl operatives are being suspended, and in some cases discharged. It is considered that this state of things is only temporary, and is due in the main to the introduction of a new American blade. The best Sheffield blades continue to hold their own everywhere for quality and efficiency. It is stated that the Sheffield trade needs an elaborate and widespread publicity campaign in all markets, but no co-operation of firms with this end has yet been announced.

Effects of Cheap Silver.

Although the market for raw silver has gained some strength lately, the material is still cheap, and this should be to the advantage of manufacturers of silver goods. It is reported, however, that, although there has been some increase in the demand, it is not what it might be because of the failure of retailers to pass the benefit on to the public. Makers' quotations have been brought down, but the old prices are being retained in many shops. Silver manufacturers, therefore, are not well placed. Their stocks of finished goods have depreciated in value owing to the fall in the price of material, but they are not receiving an adequate return in the shape of increased demand.

Tools for the Farm.

It is an ill wind that blows nobody any good, and the storms which have visited the agricultural districts of the country and have laid the crops low, should benefit Sheffield. In many fields the harvest cannot be reaped by machinery, but requires a large amount of hand labour. So far, however, Sheffield has not experienced any great rush for scythes and hooks; in fact, the season trade in such hand tools is described as having been very poor. At the same time, it is expected that stocks in retailers' hands will be exhausted before the harvest is finished, so that heavier purchases will be necessary for next season. Sheffield does an important export trade in scythes, sickles, hooks, and other farm tools, and this branch, taking the prevailing world depression into consideration, is reported to be doing fairly well,

Rotherham Trolley Omnibuses.

Rotherham Corporation Tramways Committee recommends acceptance of the tender of Cravens Railway Carriage and Wagon Works, Sheffield, for the bodies of twenty trolley omnibuses, and that of Ransomes, Sims and Jefferies, Ltd., for the chassis of the vehicles.

Coal and Gas.

The Barlborough Colliery, after being closed down for a couple of years, is likely to resume coal winding during the next month or two. The Oxcroft Colliery Company recently purchased the pit, and a number of men are now engaged on necessary work prior to its reopening. The production of coke oven gas in this district is on a scale far in excess of its use, although a great quantity is used, principally by the Sheffield Gas Company, which is among the largest consumers in the country. It is now taking steps to increase its supply, having applied for a special order which will enable it to draw gas from a larger area than is at present available to it. The object is to bring the gas to Sheffield to be utilised for industrial purposes. "We hope," said the general manager of the company, "to be able to give cheap gas, help the manufacturers to meet foreign competition, and also to help employment."

Humber Bridge Difficulty.

Difficulty has arisen over the provision of funds for the great project of bridging the Humber, near Hull, and at present the future of the scheme is in some doubt. It is the attitude of certain local authorities which has led to this situation. The estimated total cost of the bridge is £1,725,000, exclusive of legal expenses and interest on capital during the construction period. The Government's contribution of 75 per cent. will represent £1,292,750, leaving £432,250 to be provided by the local authorities, a sum which will be reduced to £287,500 by the Government's willingness to permit tolls to the amount of one-third. Hull Corporation has agreed to provide £200,000, and there have been tentative offers from the Yorkshire side of the river, but the only definite additional contribution promised so far is one of £10,000 from the Barton Urban Council. There is thus a gap of £77,000. The East Riding County Council has withdrawn from the scheme altogether, and the Town Councils of Bridlington, Hornsea, and Grimsby have also notified the Town Clerk of Hull that they will not subscribe; while the Lindsey County Council and Brigg Urban Council are undecided.

Locomotives Cancelled.

Doncaster is seriously affected by the policy of economy which has been decided upon by the L.N.E.R. Company. The construction of thirty-five locomotives, which was to have been carried out under the provisions of this year's programme, has been postponed. Of these engines, twenty-five, of a new mixed-traffic design, were originally ordered from the company's workshops at Doncaster, and the other ten from Darlington. The staff at Doncaster has been reduced by 500 during the last few weeks.

NORTH OF ENGLAND.

(From our own Correspondent.)

Big Electrical Plant Orders.

THE outstanding feature in Northern industrial circles this week has been the placing of important contracts in connection with the North-East electricity grid scheme. The most important is that, estimated at £400,000, for three 50,000-kilowatt turbo-alternators, placed by the Newcastle Electric Supply Company with C. A. Parsons and Co., Newcastle. The supply company has given out a further order in connection with the Dunston power station. This contract, which will involve the expenditure of about £200,000, is for the foundations and site works of the new station. The contractors for the work are Sir Robert McAlpine and Sons, Newcastle. A. Reyrolle and Co., of Hebburn, have received an order, amounting to about £100,000, for 66,000-volt switchgear at the sub-stations to be built at Sunderland, South Shields, and Hebburn. Further orders for other sub-stations to be built throughout the North-East are expected to be placed with the same firm, which has already carried out similar work for the "grid" scheme in other parts of England.

Cleveland Iron Trade.

Though most of the iron and steel works have resumed after the holidays, some are still idle, and not until next week will activity be fully restored. Happily, the outlook is more hopeful. The opening out of negotiations to cover autumn needs should not be long delayed, and signs are not altogether absent that these requirements will be heavier than seemed likely a little while ago. Foreign competition continues keen, but Cleveland producers hope to secure a fair share of the orders likely to be

released. Cleveland pig iron is still in ample supply, but additions to stocks are expected to cease with the growth of requirements usually experienced at the end of the holiday season. The bulk of the iron produced promises to continue to be absorbed at ironmasters' own consuming departments, and makers hope to dispose of the surplus by larger direct sales to local and other home consumers who have to come on the market for supplies. There seems little prospect of much expansion of export demand. Merchants have few opportunities of dealing in Cleveland iron, as they are precluded from selling to principal home firms, and overseas customers are putting through few inquiries. Ironmasters are determined to regulate output closely to requirements, and thus prevent stocks increasing to embarrassing dimensions. No. 1 Cleveland foundry iron is 66s.; No. 3 G.M.B., 63s. 6d.; No. 4 foundry, 62s. 6d.; and No. 4 forge, 62s.

Hematite Pig Iron.

A steadier feeling is reported in the East Coast hematite pig iron trade. Output is now little in excess of current requirements, and demand may shortly expand sufficiently to necessitate fairly substantial withdrawals from the heavy stocks. Producers are disinclined to name below the basis of ordinary qualities at 71s., though merchants are accepting rather less, and have considerable quantities to dispose of.

Iron-making Materials.

Transactions in foreign ore are very difficult to arrange, and are confined to small parcels. Consumers are not disposed to discuss new buinesss. They have substantial quantities on hand, and heavy running contracts against which to draw. Best Rubio ore is quoted 19s. c.i.f. Tees. Conditions as regards blast-furnace coke alter little. Supply is plentiful and buyers are backward. Good average qualities are still obtainable at 16s. 6d. for early delivery to North-East Coast works, but sellers are unwilling to enter into extensive forward contracts at below 17s. 6d.

Manufactured Iron and Steel.

In the manufactured iron and steel trade some heavy engineering orders and the general anticipation of antumn buying after a dull period have created a more hopeful feeling. Export business is quiet, but producers in this area are getting their share, and are allowing very few home orders to slip through their fingers. Prices are unchanged.

The Coal Trade.

There is no new development in the Northern coal trade, and no definite improvement is in sight for the next two or three weeks. Work at the pits proceeds under irregular circumstances, and whilst there are a moderate number of definite orders to place, shippers are faced with a tonnage scarcity and are unable to stem definite loading positions. For Northumberland steams, buyers can cover large at 13s. 6d. and small at 10s. Tyne primes and similar qualities are equally dull and easy at 12s. 9d., with smalls at 10s. 6d. The Durham steam coal trade is also very dull, and most of the producers are unable to clear their outputs. Sellers quote freely, but find new business difficult to attract. Large is quoted at 15s., and best small at 12s. There is a continued lack of pressure for any class of gas coal, and many of the pits are working short time. Merchants requiring prompt supplies have no difficulty in securing any class of gas coal at the recent minimum, but sellers decline to make further price concessions. Best qualities are quoted at 15s., and seconds at 12s. 6d. to 13s. Prime Wear descriptions are also unchanged at 15s., but for forward, 3d. higher is indicated. Durham coking unscreened and good ordinary bunker coal is in ample supply and weakly held at 12s. 6d. to 13s. Best bunker qualities are quoted at 13s. 6d. to 14s. There is a steady demand for gas coke, which remains scarce and firmly held at 21s. 6d. Patent oven coke for next month and onwards has a fairly good undertone. Makers hold steadily at 17s. 6d. to 18s. Beehive and superior foundry cokes are unchanged at 24s. to 28s.

SCOTLAND.

(From our own Correspondent.)

Quiet Outlook.

GENERALLY speaking, the position with regard to the steel, iron and coal markets is without alteration. Inquiries from all sources are extremely slow, owing to a lack of activity in the consuming industries. Export business moves very slowly. The outlook therefore is dull, and there is a lack of confidence due in a measure to the instability of the position on the Continent.

Steel.

Makers of heavy steel report a continued scarcity of specifications. A considerable amount of idleness is therefore unavoidable, more especially at those mills concerned chiefly in the production of shipbuilding materials. Orders for plates and sections have been most disappointing, and in view of the present state of the shipbuilding industry there is little prospect of an early improvement.

Tubes and Sheets.

Business in tubes is rather uneven. One or two producers are satisfactorily placed for some time ahead, but the majority would welcome an increasing flow of orders. Black sheets of the light variety are comparatively well specified, but heavy descriptions are rather neglected. Business in galvanised sheets is moderate. Prices are unchanged.

Iron.

The market for bar iron and re-rolled steel bars remains dull in the extreme. Prices of the former are steady, but while those for the latter are nominally unchanged, weakness is apparent when a good order is in prospect. Consequently, something less than £7 12s. 6d. per ton home or export can be secured when a prompt transaction in re-rolled steel bars is offered.

Pig Iron.

The number of furnaces in blast in Scotland does not exceed twelve, but the output is ample to meet all demands at present, and the tendency of the market is easier, though current prices are not considered remunerative.

Scrap.

Fresh dealing in scrap is on very restricted lines, and present deliveries are mostly against old contracts. Prices are easy, with cast iron machinery round about 62s. 6d., heavy steel 51s. 3d., and heavy basic 52s. 6d. per ton.

Coal.

Business in the coal market at present is of a day-to-day description. The effect of the Coal Mines Act and colliery schemes on prices causes considerable uneasiness, and transactions are not being done further ahead than October. Exporters, too, will not commit themselves far ahead in view of keen Polish and German competition in some foreign markets. Meanwhile round coal, with the exception of Lanarkshire splints, is plentiful and easy. Nuts, on the other hand, are firm, with trebles and doubles rather scarce. Aggregate shipments amounted to 210,900 tons, against 237,519 tons in the preceding week and 288,201 tons in the same week last year. Home demands show little improvement so far, but it is said that the collieries will endeavour to secure an advance of 1s. 6d. per ton early next month.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

ANTHRACITE coals continue to be very steady, and, if anything, it can be said that in the steam coal section the conditions are a trifle better. At least there is not quite so much short time being worked, though there is, of course, room for very considerable improvement. At the end of last week there was the usual clearance of tonnage, with the result that on Saturday the number of idle tipping appliances amounted to thirty-seven, but on Monday, as the result of arrivals, this figure was reduced to twenty-three, and there were seven steamers waiting. According to the Great Western Railway Company's figures, shipments of coal at the six ports under its control came last week to a total of 522,800 tons, which compared with 498,900 tons the preceding week; but when a comparison is made with the corresponding period of last year the quantity is not so good, as the total then was 630,060 tons. Unfortunately, chartering of tonnage is on a somewhat restricted scale, but this may be due to some extent to the fact that merchants are experiencing rather more difficulty in securing the tonnage that suits them. Certainly there appears to be less tonnage on offer on the market, and outward rates for some directions have a slightly steadier appearance. It can be said also that there are indications of more inquiry for cargoes, not only for prompt shipment, but for delivery at the end of this year and the early part of next. There can be little doubt that buyers who can cover their requirements ahead on the basis of existing coal prices and freight rates will come off very well, as there is only one direction in which outward rates can move, and that is upward. The present extremely low level cannot last for long. A certain amount of business is possibly held up owing to the uncertainty existing as to what may be the position in this district as the result of negotiations concerning a new wages agreement, but as soon as the market begins to move, the prospects are that buyers will come along and purchase supplies more freely. Improvement is not expected immediately, but later in the autumn, when existing stocks abroad are reduced, there should be more activity.

The New Wages Agreement.

It was announced at a meeting of the Executive Council of the South Wales Miners' Federation on Saturday last that arrangements had been made for a meeting of the South Wales Coal Conciliation Board to be held on September 8th, and at the coalowners' request consideration would be given to the bearing of the new Coal Mines Act upon the existing Conciliation Board agreement. This is the first indication of the opening of negotiations for a new wage agreement, and although it is understood that so far no proposals have been put forward by either side, there is a report current that the representatives of the miners contemplate putting forward a claim for an increase in the rates of colliery pieceworkers as compensation for the loss of half-an-hour in the working day under the new Mines Act. There can be no doubt that such an application will be strenuously resisted, as all along the coalowners have made no secret that reduced working hours will mean increased working costs and that they would have to ask for a reduction in wages. The Executive Council of the South Wales Miners' Federation has appointed its Chairman, Mr. Enoch Morrell, as its representative on the District Investigating Committee set up under the new Coal Mines Act. It may be added that at the Coal Conciliation Board meeting on September 8th consideration will be given also to the application of the workmen that a joint pension scheme for the aged workmen in the coalfield should be established, also for the uniform payment and duties of ambulance men under the new Order of the Mines Department.

Proposed Re-opening of Dowlais Works.

It came as very welcome news at the end of last week that preparations are being made for a resumption of work at the blast-furnaces and steel manufacturing department of the Dowlais (Merthyr) Works, which have been idle for about six weeks. A re-start is to be made next week, and although it may not be possible to re-employ the whole of the 1500 men who have been idle, it is hoped to find work for the great majority. It is not clear whether the works are being re-started in the expectation of much new business or for the purpose of working off old orders. It probably is due to both, but at any rate hopes are entertained of an improvement shortly in the market. The Llanharan iron ore mines near Pontyclun, which have also been idle as the result of the closing down of the Dowlais Works, are also re-opening on Monday.

South Wales Trade.

Statistics have been issued by the G.W.R. Company regarding the trade as a whole at the six ports in this district under its control. These figures, which cover the four weeks ended August 3rd give the total of imports and exports at 2,644,123 tons, made up of imports 413,521 tons and exports 2,231,602 tons. For the previous month the aggregate of imports and exports was 2,542,396 tons, made up of imports 393,407 tons and exports 2,148,989 tons. The figures for the four weeks ended August 3rd compare unfavourably, however, with the corresponding period of last year, as the total of imports and exports was then 3,143,846 tons, made up of imports 398,253 tons and exports 2,745,593 tons. For the whole of this year to August 3rd the returns of trade do not make good reading, for imports and exports amount to 21,664,785 tons, as against 22,650,254 tons for the corresponding period of last year, a loss of 985,469 tons.

Tin-plate Manufacture.

The report comes from Llanelly that, as the result of an invention for the improvement of the cleaning and finishing processes of manufacture, almost all of the manufacturers have given orders to a Llanelly firm for supplies of the new machine. This, it is stated, is based upon American practice, but it is claimed to be an improvement upon it. Experiments have for some time been carried out at the St. David's Tin-plate Works, Llanelly. It is understood that the finished article as turned out under the new process meets with an increasing demand by foreign buyers.

Current Business.

The steam coal market as a whole is again on the quiet side this week, but although the position of collieries is irregular, the fact remains that some of the leading undertakings are fairly well off for orders, though they cannot see very far ahead. Dry large coals are a shade better in tone, but small coals are easy. Sized qualities continue to be steady, while in the case of coke there is a fair inquiry. Patent fuel shows no improvement and pitwood meets with only a moderate demand, prices being about 27s. to 27s. 3d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE BROOKE TOOL MANUFACTURING COMAPNY, Ltd., of Birmingham, asks us to announce that Mr. Stanley C. Icke has been appointed chairman of the company in succession to the late Mr. A. E. Owen.

W. E. BURNAND AND CO., of Duo Works, 66–106, Shoreham-street, Sheffield, ask us to announce that they have taken over the "Phœnix" electro lifting magnet business from, and until recently carried on by, Steel, Peech and Tozer, Ltd., of the Ickles, near Sheffield.

THE BRITISH PORTLAND CEMENT ASSOCIATION, Ltd., the head office of which is at 20, Dartmouth-street, London, S.W. 1, asks us to announce that it has opened new branch offices at 15, Queen-street, Exeter, and 9–14, Exchange-buildings, Upper Hinton-road, Bournemouth, respectively.

AGRICULTURAL AND GENERAL ENGINEERS, Ltd., ask us to announce that the fire which took place on August 19th at the works of Aveling and Porter, Ltd., Rochester, was confined to a detached pattern store, quite away from the main shops, and that the output of the works will not be interfered with in any way.

EDWARD G. HERBERT, Ltd., of Atlas Works, Levenshulme, Manchester, asks us to announce that it has been appointed sole agent for the British Empire for Ateliers G.S.P., of Albert (Somme) and Paris. Ateliers G.S.P. is an amalgamation of the three French machine tool makers Guillemin-Sergot and Pégard-Gérony and Leturcq.

THOMAS BOLTON AND SONS, Ltd., of Widnes, Lancs., ask us to announce that, owing to ill-health, Mr. W. Lee Mathews, who was a director of the company and has managed its London business at 168, Regent-street, W., for more than thirty years, has resigned his position, and that Commander W. T. Bird has been appointed sales manager for the London district.

CONTRACTS.

THE CENTRAL ELECTRICITY BOARD has placed further contracts, amounting to nearly £450,000, during the last month. They include the secondary cables and pilot cables in connection with the Central England electricity scheme, the contractors for which are Siemens Brothers and Co., Ltd., Woolwich, and the Pirelli-General Cable Works, Ltd., Southampton. A second communication states that the Board has given out additional orders amounting in value to about £600,000. They include a large order for general cables in connection with the South-East England Electricity Scheme, placed with W. T. Henley's Telegraph Works Company, Ltd., London; an order for general meters required for the Central England Electricity Scheme, placed with Chamberlain and Hookham, Ltd., Birmingham; and an order for switchgear, which has been given to A. Reyrolle and Co., Ltd., Hebburn-on-Tyne, and is the first so far placed by the Board in connection with the North-East England Scheme.

INSTITUTION OF NAVAL ARCHITECTS, AWARDS.—The Council of the Institution of Naval Architects has awarded the "Institution of Naval Architects" Scholarship (1930)—£130 per annum for three years at Liverpool University—to Mr. Harold J. Tabb, of H.M. Dockyard, Devonport; and the Earl of Durham Prize to Mr. Mervyn C. Dunstan, of H.M. Dockyard, Devonport.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast.	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	19/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 18 6	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 6 0	3 6 0
Siliceous Iron	3 6 0	3 6 0
No. 3 G.M.B.	3 3 6	3 3 6
No. 4 Foundry	3 2 6	3 2 6
No. 4 Forge	3 2 0	3 2 0
Mottled	3 1 6	3 1 6
White	3 1 6	3 1 6
Midlands—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 8 6	—
„ „ Foundry	3 13 6	—
(c) Northampton—		
Foundry No. 3	3 10 0	—
Forge	3 5 0	—
Derbyshire—		
No. 3 Foundry	3 13 6	—
Forge	3 8 6	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (a) / 4 6 6 (b) / 4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	12 15 0	12 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 17 6 to 8 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 15 0	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	9 15 0	—
Soft Wire Rods	8 0 0	—
Midlands—		
Small Rolled Bars	7 17 6 to 8 10 0	—
Billets and Sheet Bars	5 17 6 to 6 5 0	—
Galv. Sheets, f.o.b. L'pool	11 17 6	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/1½
Block Tin (cash)	132 15 0
„ (three months)	134 7 6
Copper (cash)	46 16 3
„ (three months)	46 18 9
Spanish Lead (cash)	18 5 0
„ „ (three months)	18 2 6
Spelter (cash)	15 12 6
„ (three months)	16 3 9
Manchester—	
Copper, Best Selected Ingots	51 10 0
„ Electrolytic	52 0 0
„ Strong Sheets	79 0 0
„ Tubes (Basis Price), lb.	0 0 11½
Brass Tubes (Basis Price), lb.	0 0 10½
„ Condenser, lb.	0 1 0½
Lead, English	19 12 6
„ Foreign	18 5 0
Spelter	16 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 12 6	7/-
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/-
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 10 0	10/-
„ „ „ 1 p.c. carbon	£38 0 0	13/6
„ „ „ 0·70 p.c. carbon	£39 0 0	15/-
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
„ „ „	£11 0 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 per unit	scale 5/-
„ „ 75 p.c.	£19 0 0 per unit	scale 7/-
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
„ „ Ell	13/6
„ „ Splint	14/6 to 16/-
„ „ Trebles	13/-
„ „ Doubles	12/6 to 13/-
„ „ Singles	11/6 to 11/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	16/-
„ „ Trebles	13/6
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	10/9 to 11/9
Screened Navigation	16/6 to 17/6
Trebles	13/- to 14/-
Doubles	12/6 to 13/-
Singles	11/6 to 12/-
Lothians—	
(f.o.b. Leith)—Best Steam	11/-
Secondary Steam	10/9
Trebles	13/-
Doubles	12/9 to 13/-
Singles	11/6 to 12/-

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		20/6 to 21/-
Household		32/- to 51/-
Coke		20/- to 21/-
Northumberland—		
Best Steams		13/6
Second Steams		12/-
Steam Smalls		10/- to 10/6
Unscreened		12/6
Household		26/- to 37/-
Durham—		
Best Gas		14/9 to 15/-
Second		12/9 to 13/-
Household		25/- to 37/-
Foundry Coke		24/- to 26/-
Sheffield—		
Best Hand-picked Branch	24/- to 25/6	—
Derbyshire Best Bright House	19/- to 21/-	—
Best House Coal	18/- to 19/6	—
Screened House Coal	16/- to 17/-	—
„ „ Nuts	14/- to 16/-	—
Yorkshire Hards	14/- to 15/6	—
Derbyshire Hards	14/- to 15/6	—
Rough Slacks	8/6 to 9/-	—
Nutty Slacks	7/- to 8/-	—
Smalls	3/- to 5/-	—
Blast-furnace Coke (Inland)	15/6 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.		17/- to 18/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/-
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/- to 18/3
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/6 to 17/-
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/6 to 13/-
Washed Nuts	19/- to 22/-
No. 3 Rhondda Large	20/- to 20/6
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	16/- to 16/6
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	27/6 to 37/-
Furnace Coke (Export)	21/- to 21/6
Patent Fuel	22/-
Pitwood (ex ship)	26/9 to 27/3
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	23/6 to 27/-
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/6 to 27/6
Peas	20/- to 21/-
Breaker Duff	10/- to 10/6
Rubbly Culm	11/6 to 12/-
Steam Coals:	
Large	19/6 to 21/6
Seconds	18/- to 19/6
Smalls	12/- to 13/-
Cargo Through	15/6 to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/- if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country stations.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Situation.

NOTWITHSTANDING the efforts being made to provide activity to the mills and forges by distributing orders for railway rolling stock and other material and putting in hand as many public works as possible compatible with the funds available, there has been a continuous decline of business, and rolled steel, except sheets and plates, which are unchanged, is offered at lower prices. Much more work will be forthcoming when the large number of public works now held up can be resumed and other undertakings can be started upon in pursuance of the national problem of economic equipment; but there seems to be some difficulty in providing the huge amount of money necessary, though the Government has always declared it has kept it in reserve for the purpose. One explanation is that the giving out of contracts is delayed until a committee has decided upon how they can be entered upon without incurring the risk of inflating prices and rarefying labour. Meanwhile it is recognised that the manufacturing industries cannot depend entirely upon home public works and that more attention must be paid to foreign markets, but that is where French makers find themselves in an unsatisfactory position for doing business. Not only are the sales of manufactures abroad declining, but France is purchasing more foreign goods. The fact that dominates the situation at the moment is the fear of competition from the United States. It is pointed out that living costs are declining in the States and that wages are being reduced in many industries, wherefore it is assumed that the Americans are getting down their production costs with a view to competing more successfully in European markets. All this is disturbing to French manufacturers, who are by no means satisfied with the turn events have taken in consequence of the tendency towards higher costs. Nevertheless, while the outlook is by no means reassuring, there continues to be fair employment in many of the engineering shops. Until now the steel makers have been producing up to the limit of their quota and have even slightly exceeded it, while all other members of the Cartel have considerably reduced their steel output.

Foreign Capital.

The investment of foreign capital in home undertakings is discouraged on the ground that it may offer some risk from the point of view of national security, at all events when foreign participation goes to the extent of controlling national industries. That is the case with hydro-electric distribution, which is partly in the hands of a group supported by the Electro-Bank of Zurich, and the fact of its asking for further concessions has aroused protest from the Toulouse Chamber of Commerce, which asks the Government to insist that at least two-thirds of the capital in these undertakings should be French. Electrical engineering is also largely controlled by foreign capital, and attempts have been made by American groups to secure a controlling interest in some French motor car undertakings. The French resent any foreign participation which aims at taking business out of their hands, and although an American group has monopolised one motor car firm in this country, with indifferent results, American capital has not succeeded to anything like the same extent as it has in Germany, where a large number of factories are now under American control. It is stated that a company is being formed in Italy by Ford in order to acquire the Issotta-Fraschini works for the manufacture of Ford cars. The cars are at first to be assembled with parts imported from the United States, and it has been declared that Italian opposition is one reason why the representatives of the continental motor car industry failed to come to an agreement for a restriction of car imports from America when the matter was discussed at the recent meeting in Paris. There is reason to believe that the Ford proposal has not yet left the stage of negotiation. Nevertheless, the participation of American capital in industrial enterprises is a factor in improving the situation of American manufacturers in European markets.

The Late Monsieur Charles Frémont.

Monsieur Charles Frémont has died in Paris at the age of seventy-five years. For more than forty years he devoted himself to metallurgy and to methods of testing metals, with which his name is now universally associated. His research work in the testing of metals was considerable, and he made voluminous contributions on the subject which are accepted as authoritative by French metallurgists. Some of his methods are criticised abroad, and Monsieur Frémont himself never admitted that he had achieved finality, for he was always endeavouring to improve upon what he had already accomplished. He rendered an important service to metallurgy by introducing testing devices at a time when little had been done to apply scientific methods to that purpose. Monsieur Frémont, who continued his research work down to within a short time of his death, was awarded the gold medal of the Société d'Encouragement à l'Industrie Nationale in 1920, while in the following year he received the Bessemer gold medal of the Iron and Steel Institute.

Reinforcement Tubes.

The Office National des Recherches et Inventions, which is a State experimental department, is carrying out tests with steel tubes for concrete reinforcement. The results so far are sufficiently encouraging to give promise of providing a new method of reinforcement superior in many ways to the use of steel rods. The tubes are filled with concrete, and while that is being done they are kept in a condition of stress so that they will bind on the concrete when dry. It is stated that the process is likely to have many interesting applications. Concrete reinforced in this way is found, it is said, to offer a greater resistance to compression than either concrete or tubes of the same section taken separately. It is also claimed to have other advantages, and the experimenters believe that they have evolved a system of reinforcement that is likely to be of great value, but those claims will be verified by further tests before they are put forward as being proved.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

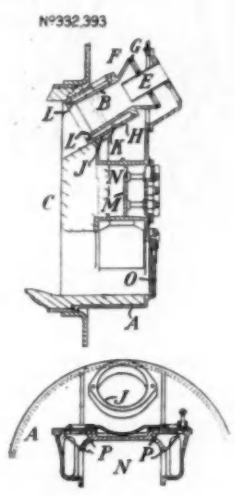
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

332,393. July 11th, 1929.—FURNACE FRONTS, James Howden and Co., Ltd., of 195, Scotland-street, Glasgow; and James Howden Hume, of Caxton House, Westminster, S.W. 1.

This invention relates to improvements in furnace fronts applicable to furnaces for burning pulverised fuel, which may have, in addition, provision for burning oil or for burning coal fired by hand. More particularly the invention relates to a furnace front of the type equipped with a fitting for burning pulverised or atomised fuel. Within the furnace front casting A there is a fitting for burning pulverised or atomised fuel comprising a downwardly inclined nozzle B diverging into the mouth of the furnace C. An injector tube E is adapted to accommodate in its interior a pulverised or atomised fuel burner (not shown).

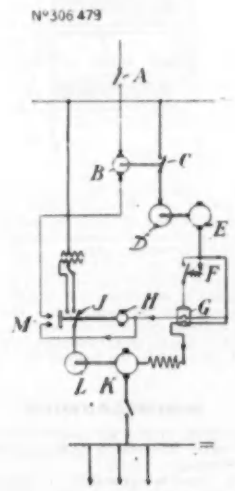


The tube E passes through a ported plate F fitted to the outer end of the nozzle B and controlled by a ported valve disc G, which may be rotated by spur gearing from a hand wheel so as to regulate the supply of secondary air to the nozzle B, which is surrounded by a ported sleeve H filling an aperture J and bounding an annular space K communicating with air ports L in the lateral wall of the nozzle B near the inner end thereof, the ports L serving to admit a further air supply supplemental to the secondary air admitted through the ported plate F. When burning pulverised fuel, the fuel is, of course, injected along with primary air. O denotes the usual firing door for hand firing of coal. When the nozzle B is out of use the aperture J is closed by means of a stopper and secondary air is admitted to the furnace by way of valve-controlled ports P on each side of the opening N for the door M.—*July 24th*, 1930.

DYNAMOS AND MOTORS.

306,479. January 17th, 1929.—CIRCUIT CONNECTIONS FOR STARTING SYNCHRONOUS CONVERTERS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

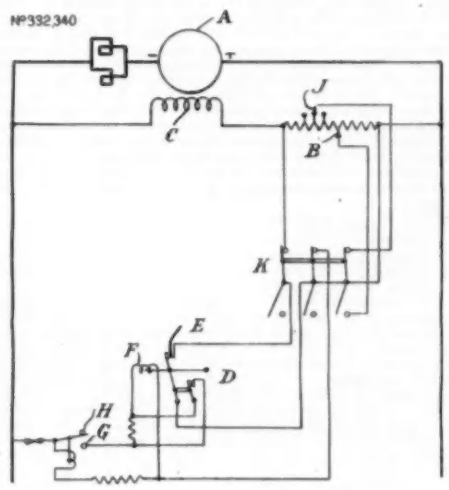
The invention has reference to synchronous converters which can be controlled from a distance, when, for example, there is no direct current available for actuating the controlling members and for the excitation of the field winding of the synchronous converters, or when the direct-current voltage available cannot be used for the excitation of the field winding or operation of the



controlling members. The arrangement according to the inventor is especially suitable for securing the proper polarity of synchronous converters, started from the alternating-current side, which require to be excited with direct current. A is a control switch which transmits the switching-in signal from the control station to the remote synchronous converter. B is a switch motor which actuates the main switch C of the auxiliary converter set which consists, for example, of an asynchronous motor D and a direct-current generator E. When the direct-current generator E has reached its voltage, a switch F is operated, whereby the voltage relay G is excited, which in turn actuates the driving motor H of the alternating-current main switch J, so that the alternating-current side of the synchronous converter K L is connected to the starting voltage. When the relay G comes into action, in order to ensure correct polarity of the synchronous converter K L, the converter is excited from the direct-current generator. When the converter has approximately attained synchronism, the alternating-current side is automatically switched over to full voltage. When the switching-in signal has thus been carried out, a circuit is closed at the contacts M to cause the switching motor B to cut off the auxiliary converter set D E at the switch C, the field winding of the generator K being connected across the brushes in the usual manner. The auxiliary converter set could also be used for supplying direct current to the members serving for switching-in the consumers connected to the direct current side. In order to equalise the voltage of the converter after starting with the voltage of the direct-current mains to which it is to be connected, relays are required which do not operate on the magnitude of the voltage of the converter and of the mains, but on the direction of the current. For this purpose use is made of polarised relays; that is to say, relays which have a separate excitation for securing their proper polarity. The auxiliary converter can also be used for supplying the voltage for the excitation of these polarised relays. In that event the auxiliary converter is not cut out of circuit until after the synchronous converter has been connected to the direct-current mains and the polarised relays no longer require the exciting voltage.—*July 17th*, 1930.

332,340. May 21st, 1929.—METHODS OF AND APPARATUS FOR STARTING AND SYNCHRONISING DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London W.C. 2; and Frank Percy Whitaker, of 237, Clifton-road, Rugby, Warwick.

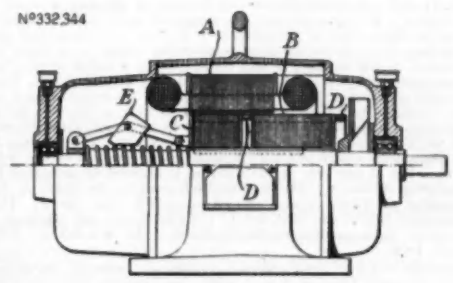
It is well known that when starting rotary converters by the series induction motor method, or when starting induction motors with reactance coil synchronising and also when starting motor converters it is necessary, when synchronous speed is reached for the field to be of such a strength as to generate across the direct-current brushes a voltage which is not too high or too low. The object of this invention is to ensure the correct voltage being generated across the direct-current brushes when the machine attains synchronous speed. The direct-current side of the machine is represented generally at A, and a rheostat B is connected in series with the shunt field C. A contactor D is connected across the rheostat B so that when its contacts E are closed the rheostat is short-circuited. The contactor D has an opening coil F which is arranged to be



operated by the direct-current voltage of the machine on the closing of the contacts G H of a relay, the operating coil of which is connected across the direct-current side of the machine. A change-over switch K is shown connected in the circuit of the contactor F and relay so that these latter may be cut out of operation when the machine has been started up. The switch is shown in the "starting" position. A tapping switch J is provided on the rheostat B so that the amount of resistance in circuit in the starting position may be varied independently of the normal running resistance. The operation of the apparatus is as follows:—On starting up, the main contacts E of the contactor D are closed, thus short-circuiting the shunt field rheostat B. When the machine direct-current voltage has reached a desired value, the contacts G and H of the relay close, thus energising the coil F of the contactor D and causing the main contacts E of the contactor to open to insert a predetermined amount of the shunt field rheostat in series with the shunt field. As a result of inserting resistance in the shunt field the direct-current voltage falls, the relay and contactor D return to their original positions and the shunt field rheostat is again short-circuited. The direct-current voltage again builds up to the required value, and the relay and contactor come into operation, resistance is inserted in the shunt field and the direct-current voltage falls. This sequence of operations is continued and the direct-current voltage is maintained as desired during starting and synchronising.—*July 24th*, 1930.

332,344. May 28th, 1929.—ALTERNATING-CURRENT INDUCTION MOTORS, Adolf Baier, of Birsfelden, near Bale, Switzerland.

This invention relates to an alternating-current induction motor of the kind in which two rotors are provided on a shaft within a stator, one of the rotors being a low-resistance rotor for



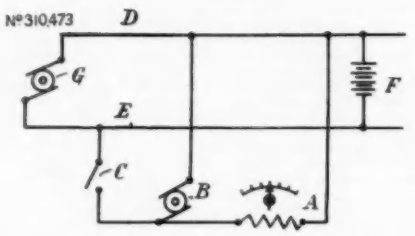
normal running, and the other a high-resistance rotor serving for starting, the stator and pair of rotors being adapted to be moved relatively to one another so that, upon starting the high-resistance rotor, and during normal running the low-resistance rotor is in its operative position in relation to the field of the motor. A is the stator of the motor, B the low-resistance or

short-circuited rotor, and C the starting or high-resistance rotor. The two rotors are mechanically connected inside the stator A to one another, and are adapted to be moved longitudinally on the motor shaft by virtue of a groove and feather connection therewith. The short-circuited rotor B has the usual winding bars, which are short circuited through the end rings D. The starting rotor C, which plays the part of an auxiliary armature, is provided with a resistance winding. The sliding movement of the two rotors B C along the shaft is arranged to be automatically effected by the centrifugal force exerted by pivotally mounted weights E which are adapted gradually to move the starting rotor C away from its operative position and at the same time move the short-circuited rotor towards its operative position as the speed of the motor increases.—*July 24th*, 1930.

MEASURING AND TESTING INSTRUMENTS.

310,473. April 24th, 1929.—Apparatus for Indicating Battery Condition on Motor Vehicles, Schoeller and Co., Elektrotechnische Fabrik G.m.b.H., of No. 117, Mörfelderlandstrasse, Frankfurt-on-the-Main, Germany.

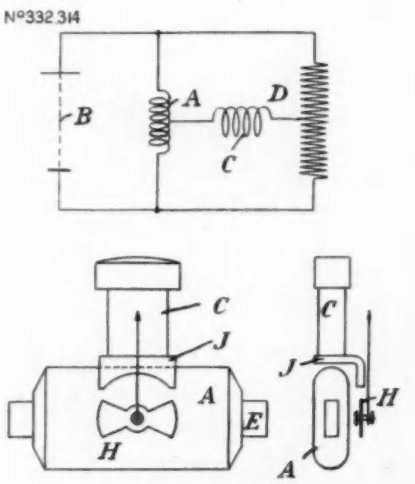
This invention relates to the electrical equipment of motor cars fitted with storage batteries and electric starters and the object of the invention is to provide new or improved means for indicating the condition of the storage battery so as to give the user early warning of the fact that the battery has become discharged. The voltmeter A is connected across the terminals of the starting motor B so that when the switch C is closed to



start the motor B the voltmeter is connected in parallel to the motor across the conductors D E and storage battery F. When the switch C is open both the starting motor and the voltmeter are on open circuit, but when the switch C is closed the voltmeter indicates the voltage across the terminals of the storage battery. When the battery is discharged the load of the starting motor will cause the voltage across the battery to fall substantially below its normal value, and the reading of the voltmeter will therefore serve as a reliable indication of the condition of the battery. The usual generator is shown at G, and although no lamps or other apparatus are illustrated, it will be understood that the usual lamps and other apparatus including the relay or regulator necessary to prevent the dynamo from motoring will be connected to the system in the usual manner.—*July 24th*, 1930.

332,314. April 30th, 1929.—Electrical Liquid Level Indicating Instruments, S. Smith and Sons (Motor Accessories), Ltd., of Central Works, Edgware-road, Cricklewood, London; and Ernest Analey Watson, of Victoria Works, West Orchard, Coventry.

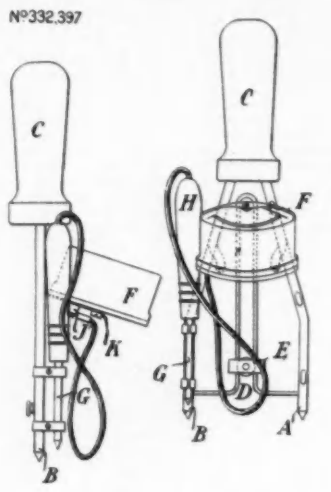
This invention relates to electrical liquid level indicating apparatus of the kind comprising a potentiometer device having a movable contact operated by a float, and adapted for use more particularly as a petrol gauge for motor vehicles. The apparatus comprises two main parts, namely, the potentiometer device, which is arranged in the petrol or other tank, and an indicating instrument arranged on the dashboard or other convenient part. The movement of an indicating finger of the instrument is determined by directional changes in a magnetic field. In a moving iron instrument the field is provided by current passing through



a main control winding A. The ends of this winding are connected to a battery B. To the centre or any other suitable and convenient intermediate point of the control winding A another winding C is connected and is arranged in series with a contact which slides over a potentiometer D. By so connecting the winding C to A it becomes possible to obtain a reversal of current in the winding C and consequently a much larger flux variation than is possible with the ordinary arrangement. Preferably, the fluxes due to the two windings are superimposed at right angles, but that is not essential so long as the two fields are superimposed at a suitable angle. A convenient arrangement of the windings is shown in the lower drawings. The winding A is carried on a soft iron core E and in that portion of the field which lies at one side of the winding is pivoted an armature H carrying an index. Above A and adjacent to the index is the winding C, which is also carried on a soft iron core J. The armature lies in the field due to the two fluxes and takes up a position corresponding to the resultant of the two fluxes.—*July 24th*, 1930.

332,397. July 13th, 1929.—Voltage Testing Devices, Ferranti, Ltd., of Hollinwood, in the County of Lancaster; and Wilfred Holmes, of the same address.

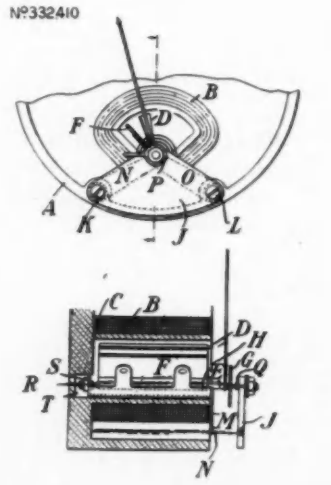
This invention relates to voltage testing devices and more particularly to such devices intended for use for testing heavy discharge electric accumulators. The object is to provide improved or simplified constructions of such devices. Two pointed metal prong members A B, which are rigidly secured to a handle C of insulating material and are interconnected electrically by means of a cranked bar D of resistance material of low temperature coefficient are employed. The resistance bar is provided with a slider E which can be clamped in any alternative position so as to vary the actual ohmic resistance inserted between the two prongs A B. Figures engraved on one of the main prongs relate to the discharge current passed by the testing set when the slider is opposite the appropriate mark. The provision of the slider E enables a limited range of adjustment with a definite resistance element and the removal of the slider does not open the circuit connecting the two spikes. A voltmeter F, preferably of the moving coil type having very good damping qualities, enables readings to be taken in the minimum of time. Mounted upon, but insulated from, one of the prongs there is another spike G, which is slidable in connection with its prong by an operating handle H, and this additional spike is con-



nected electrically by means of flexible insulated wire to one terminal J of a voltmeter, the other terminal K being connected to the prong A which does not carry this additional spike. In operation, the two main prongs A B are pressed into contact with the terminals or the lead connectors of an electric accumulator cell and the additional spike is pressed into contact with the associated terminal or connecting bar. The reading on the voltmeter indicates the potential difference of the cell under conditions of heavy discharge, the rate being determined by the value of the ohmic resistance inserted. If it is desired to use the voltmeter for ordinary open circuit tests, the additional spike is used as one connection point while either of the main spikes constitutes the other connection point.—*July 24th*, 1930.

332,410. July 23rd, 1929.—Cock Pieces for Electric or other Instruments, Nalder Brothers and Thompson, Ltd., and Francis Henry Nalder, both of 97a, Dalston-lane, London, E. 8.

This invention relates to cock pieces for supporting the spindles of the rotatable members of electric or other instruments, such as ammeters and voltmeters. A is the casing of the instrument, and B the energising coil surrounding a tube C. The moving member is a vane D secured to a spindle and repelled from a fixed vane F against the controlling action of a spring G, the

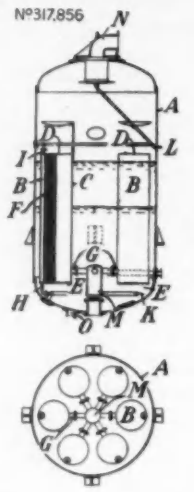


members D and F being inserted in the tube C. The vane D is fastened to a thin tube H surrounding and rigid with the spindle, which is supported at the front end in a plate J secured to the casing A by screws K L passing through holes in distance pieces M and arms N O integral with a cock piece P surrounding the spindle to which the fixed vane F is secured. The spindle is supported at the front end in a jewelled bearing Q screwed in the plate J, and at the rear end in a second jewelled bearing R supported in the cock piece. The bearing R has a circular portion S concentric with the centre of the bearing and with the axis of the spindle and is adapted to engage closely in a circular recess T provided in the base of the casing.—*July 24th*, 1930.

MISCELLANEOUS.

317,856. August 21st, 1929.—Apparatus for Supplying Low-pressure Steam, Weigelwerk Aktiengesellschaft, of Neisse-Neuland, Germany.

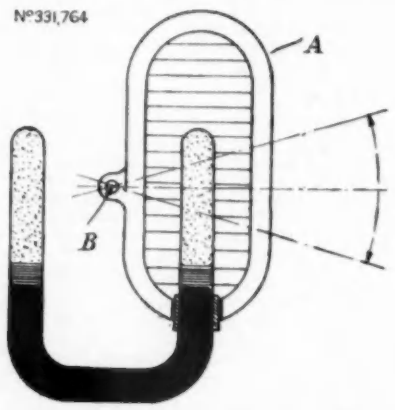
This invention relates to apparatus for obtaining low-pressure steam with the aid of a high-pressure supply. The apparatus consists of a closed vessel A in which one or a number of heating elements B are placed. Each heating element consists of a cylindrical sheath C closed by plane or arched covers D E. Tubes F are inserted in the covers and form the actual heating surface. Each heating element has a neck G through which the high-pressure steam is introduced and a connection H through which the precipitated water of condensation is removed, and at the upper cover has a connection I for removing non-condensible gases. In the case of a number of heating elements B the condensed water and gas are each collected in closed annular tubes K and L respectively and removed through the outer wall, whereas the heating steam is preferably supplied to the heating bodies by way of a distributor head M. The saturated steam produced passes out of the steam transformer through the pipe N, the mud which is formed in the course of the process being



removed periodically or continuously through the mud outlet. The advantages claimed for the scheme are fully described.—*July 24th*, 1930.

331,764. September 19th, 1929.—A Mechanism for Rewinding Clocks, &c., by Means of Variations in the Temperature of the Air, J. L. Reutter, 9, rue du Sommorwid, Paris, France.

The general scheme of this idea is to have a closed U-tube containing mercury surmounted by, say, a layer of ammonia



or carbonic acid. One leg of the U-tube is exposed to the changes of atmospheric temperature, while the other is shielded from such immediate effects by the Dewar flask A. As a consequence of variations in temperature, the mercury is displaced in the legs of the U-tube and its movement can be utilised by allowing it to act about such a fulcrum as B to actuate any mechanism such as that of rewinding a clock.—*July 10th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY to WEDNESDAY, SEPTEMBER 3rd to 10th.

British Association for the Advancement of Science.—Bristol meeting. The presidential address, by Professor F. O. Bower, will deal with "Size and Form in Plants." Evening discourses will be given by Professor E. V. Appleton, F.R.S., on "Wireless Echoes," and by Dr. R. E. Slade on "The Nitrogen Industry and our Food Supply." Evening receptions and excursions to points of scientific interest, works, &c., in the locality will be arranged.

THURSDAY to SUNDAY, SEPTEMBER 4th to 7th.

International Congress of Consulting Engineers.—Fifth Congress at Vienna.

TUESDAY to FRIDAY, SEPTEMBER 9th to 12th.

Institute of Metals.—Annual autumn meeting, Southampton. Continued from September 13th to September 16th by a visit to France. The meetings at Southampton will be held in the Chantry Hall, and on September 9th Professor D. Hanson will read a paper on "The Use of Non-ferrous Metals in the Aeronautical Industry." 8 p.m. For programme see page 88.

SATURDAY, SEPTEMBER 13th, to SATURDAY, SEPTEMBER 20th.

Liverpool.—Centenary celebrations of the Liverpool and Manchester Railway.

WEDNESDAY to WEDNESDAY, SEPTEMBER 17th to OCTOBER 1st.

Building Trades Exhibition.—At Olympia, London.

SUNDAY to WEDNESDAY, SEPTEMBER 14th to 17th.

Newcomen Society.—Summer meeting at Liverpool.

FRIDAY to SUNDAY, SEPTEMBER 19th to 21st.

Women's Engineering Society.—Lady Margaret Hall, Oxford. Eighth annual conference.